THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. XXII. No. 544.] LONDON, JULY 29, 1873. [25TH YEAR.] Price 1s. 4d.

RAMSAY'S NEWCASTLE CANNEL COAL. Analysis—10,000 cubic feet of gas per ton of coal; 25-candle gas; 13¼ cwt. coke per ton of coal.

The London Exhibition in 1851 was lighted with gas made from Ramsay's Cannel.

RAMSAY'S PATENT CONDENSED COKE.
DO. GARESFIELD COKE.

RAMSAY'S FIRE-CLAY ARTICLES.

GAS-RETORTS, introduced 1828. FIRE-BRICK WORKS, established 1804. FIRE-CLAY SANITARY PIPES, CHIMNEY-TOPS, and all Goods made of Fire-Clay. The Fire-Clay is worked from Blaydon Main Colliery, is of excellent quality, and no expense spared in perfecting every article. The FIRE-BRICKS (marked "RAMSAY") are to be seen in all parts of the world, and the Works are the most extensive in the Kingdom.

Manufactories—Derwenthaugh, Swalwell, and Hebburn Quay, near Newcastle-on-Tyne; and London Wharves—Falcon Wharf, No. 60, Bankside; and Honduras Wharf, Cubitt Town. Large stocks kept.

Address G. H. RAMSAY, NEWCASTLE-ON-TYNE.

GEORGE GLOVER & CO.,

Patentees of the Standard Gasometers for the Government, and of the

IMPROVED DRY GAS-METERS.

These Meters are warranted to measure correctly and not to vary. Their acknowledged superiority has brought them into general use more rapidly than any Meters hitherto manufactured.

To meet the increasing demand, G. GLOVER AND CO. have just entered on possession of extensive premises adjoining their present Works in Ranelagh Road, and they are now prepared to execute promptly, orders to any extent. They keep in stock all sizes of Meters up to 200 lights. In cases of haste, on the receipt of a telegram early on one day, their Meters can be delivered next day in any part of England, and in the large towns in Scotland.

Particulars and lists of prices forwarded on application to—

RANELAGH ROAD, PIMLICO, LONDON, S.W.;
236, GEORGE STREET, GLASGOW;
OR
15, MARKET STREET, MANCHESTER.

COWEN'S PATENT FIRE-CLAY RETORTS.

JOSEPH COWEN and CO.,

BLAYDON BURN, NEAR NEWCASTLE-ON-TYNE,

Were the only parties to whom a PRIZE MEDAL was awarded at the GREAT EXHIBITION of 1851, for "GAS-RETORTS and other OBJECTS in FIRE-CLAY," and they have also been awarded in the INTERNATIONAL EXHIBITION of 1862, the PRIZE MEDAL for "GAS-RETORTS, FIRE-BRICKS, &c., for EXCELLENCE of QUALITY."

J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts in the United Kingdom; and orders for Fire-Clay Retorts of all shapes and dimensions, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.

COWEN'S GARESFIELD COALS.
Coal Office,
QUAY SIDE, NEWCASTLE-ON-TYNE.

JOHN RUSSELL AND CO.,

THE OLD TUBE-WORKS, WEDNESBURY
AND
THE ALMA WORKS, WALSALL,
Established at the commencement of Gas Lighting.

WAREHOUSES:
60, UPPER THAMES STREET;
COMMERCIAL STREET, SPITALFIELDS;
5, CHARLES STREET, SOHO; and
16, SOHO SQUARE,
} LONDON
35, 36, 37, & 39, GRANBY ROW, MANCHESTER.

J. R. and Co. are the original manufacturers of Wrought-Iron Gas Tubes and Fittings, and Inventors of the LAP-WELDED TUBES for Locomotive and Marine Boilers.

J. R. and Co. make all kinds of Tubes and Fittings for Gas, Steam, and Water; Gun-Metal Cocks, Stocks, and Dies; Galvanised Tubes and High-Pressure Tubes, &c.

Lists may be obtained on application to
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JOHN BENT & SON,

WET AND DRY GAS-METER
AND
STREET-LAMP
MANUFACTURERS,
BELL BARN ROAD, BIRMINGHAM.
ESTABLISHED 1838.

All materials found for the alteration of Public Lamps for lighting with the Rod. Regulators with Lava Burners.

BLAYDON BURN AND LOW BENWELL FIRE-CLAY RETORT AND FIRE-BRICK WORKS,
NEAR NEWCASTLE-ON-TYNE.

WILLIAM COCHRAN CARR begs most respectfully to thank the Metropolitan, Provincial, and Continental Gas Companies for their patronage for several years past, and to intimate that he has rebuilt and enlarged his extensive premises for the manufacture of CLAY RETORTS; and that he is now prepared to execute the largest orders with punctuality and despatch. Orders for FIRE-CLAY RETORTS, of all shapes and sizes, FIRE-BRICKS, and all other articles in Fire-Clay, executed on the shortest notice, and on the most reasonable terms.

London Agents: JAMES LAWRIE & CO.,
63, OLD BROAD STREET, CITY, LONDON.

SCOTTISH CANNEL COAL.

J. & W. ROMANS, Consulting Gas Engineers and Coal Factors, of Edinburgh and London, CONTRACT for supplying any quantity of COAL and CANNEL.

They are also Contractors for leasing Gas-Works, for supplying, erecting, or repairing gas apparatus and fire-clay goods.

Messrs. ROMANS, being lessees of several Gas-Works, have their Cannels tested in the ordinary working process, thus securing for their customers a guarantee beyond mere laboratory experiments.

Analysis, prices, and other information will be forwarded on application to their Offices, 8, Forth Street, EDINBURGH; 1, Walbrook, Mansion House, LONDON, or to the "Crown Wharf," Thomas Street, Limehouse, LONDON, where stocks of house, steam, and gas coal are always on hand.

Coal, machinery, fire goods, &c., shipped to all parts of the world.

LESMAHAGO GAS COAL,

AUCHINHEATH COLLIERY,

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JAMES FERGUSON & CO.

LESSEES SINCE 1832.

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63, OLD BROAD STREET, E.C.

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LA COUR & WATSON,

LEITH.

GEORGE GLOVER AND CO.,

Patentees of the Standard Gasometers for the Government,

TWO MEDALS,

LONDON, 1862.

HAVE OBTAINED THE

HIGHEST

PRIZE

FOR

SILVER MEDAL,

PARIS, 1867.

IMPROVED DRY GAS-METERS AND GASOMETERS,

AT THE

PARIS EXHIBITION.

RANELAGH WORKS, RANELAGH ROAD, PIMLICO, LONDON, S.W.;

AND 236, GEORGE STREET, GLASGOW.

HENRY HOWARD & CO.,

COOMBS WOOD PATENT TUBE-WORKS,

OLD HILL, near DUDLEY,

MANUFACTURERS OF

HOWARD'S PATENT IMPROVED WROUGHT-IRON TUBES,

FOR GAS, STEAM, AND WATER;

Also ORDINARY WELDED WROUGHT-IRON TUBES and FITTINGS,

FOR GAS, STEAM, & WATER, EITHER BLACK, GALVANIZED, OR ENAMELLED.

CORE BARS FOR IRONFOUNDERS, STOCKS, TAPS, AND DIES, IRON COCKS, &c.

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SILVER MEDAL, PARIS EXHIBITION, 1867.

LLOYD AND LLOYD,

ALBION TUBE-WORKS, BIRMINGHAM,

MANUFACTURERS OF

WROUGHT-IRON TUBES AND FITTINGS

For Gas, Steam, Water, &c.

SOLE LICENSEES AND MANUFACTURERS for the United Kingdom of

THE LAVENANT PATENT ENAMELLED TUBES AND FITTINGS.

LAP-WELDED IRON & HOMOGENEOUS METAL TUBES

For Locomotive, Marine, and Stationary Boilers.

Boiler-Tube Ferrules, Gun-Metal Gland Cocks, Water-Gauges, Whistles, &c.; Stocks, Taps, and Dies for Screwing, and Gas-Fitters Tools of all kinds.

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LONDON: No. 157, Upper Thames Street, E.C. **LIVERPOOL:** No. 63, Paradise Street. **MANCHESTER:** Barlow's Croft, Chapel Street, Salford. **PARIS and LILLE.**

LAMBERT BROTHERS, WALSALL.

ALPHA TUBE & FITTING WORKS

R. LAIDLAW AND SON,

EDINBURGH AND **GLASGOW.**

Manufacturers of

CONSUMERS IMPROVED WET GAS-METERS,

THE UNVARYING WATER-LINE GAS-METERS,

IMPROVED DRY GAS-METERS, in Cast-Iron or Tin-Plate Cases;

STATION-METERS, ALL SIZES, up to 15 feet Square, with PLANED JOINTS;

Experimental Meters, Photometers, Pressure-Gauges,

Governors, Test Holders, &c., &c.

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TRADE MARK.

THE MEDAL FOR 1862.

The only Prize Medal awarded for TUBES & FITTINGS.

CROWN TUBE-WORKS,

WEDNESBURY, STAFFORDSHIRE.

WAREHOUSE: SOUTHWARK STREET, LONDON.

JAMES RUSSELL & SONS, LIMITED,

PATENTEES & FIRST MAKERS OF WROUGHT-IRON TUBES,

ONLY MAKERS OF HOMOGENEOUS METAL TUBES.

MANUFACTURERS OF

TUBES and FITTINGS for GAS, STEAM, and WATER;

LAP-WELDED, LOCOMOTIVE, MARINE, and other BOILER TUBES;

HYDRAULIC TUBES, BEDSTEAD TUBES, WELL TUBES, TELEGRAPH POSTS, COILS, &c.;

GAS-FITTERS TOOLS, VALVES, COCKS, &c.

THOMAS PIGGOTT & CO.,

(Established 1822,)

SPRING HILL, BIRMINGHAM.

MANUFACTURERS OF

TELESCOPIC & SINGLE GASHOLDERS,

CAST & WROUGHT IRON TANKS FOR DITTO;

PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS, VALVES;

IMPROVED WROUGHT-IRON RETORT-LIDS, CROSS-BARS, & SCREWS;

AND GAS APPARATUS OF EVERY DESCRIPTION.

SOLE MANUFACTURERS OF LIVESEY'S PATENT GASHOLDER MAN-LID,

By use of which Man-lid, inlet and outlet pipes can be examined and cleansed without loss of gas in crown of holder, or ingress of atmospheric air.

ROOFS, GIRDERS, BRIDGES, AND BOILERS OF ALL KINDS.

Drawings, Specifications, and Estimates supplied on application.

London Agent: W. G. DAVIS, 2, BRABANT COURT, PHILPOT LANE, E.C.

PARIS, 1867.

CLASSES 24 and 53.

WILLIAM SUGG,

GAS ENGINEER.

LONDON, 1862.

CLASSES 13 and 31.

PUBLIC LAMP GOVERNORS, LEVER COCKS, AND POLE LIGHTERS.

LAMP METERS AND BOXES

IMPROVED LOWE'S JET PHOTOMETERS.

VINCENT WORKS, VINCENT STREET, WESTMINSTER, S.W.

1862.

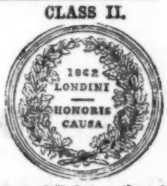
PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

CLASS II.



This Paint having been in general use over eleven years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

Reference is kindly permitted by the Engineers of the City of London, Commercial, London, and Surrey Consumers Gas Companies, who pronounce it the best Paint known for their purposes.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

TO ENGINEERS, GAS COMPANIES, RAILWAY COMPANIES, &c.

THE TORBAY PAINT COMPANY,

SOLE PROPRIETORS OF

GOVERNMENT PATRONAGE, ADMIRALTY & WAR OFFICE.

CALLEY'S GENUINE "TORBAY" PAINT

AND

THE ANTI-GALVANIC PAINT.

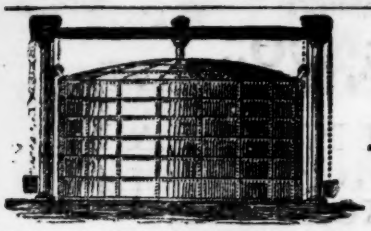
THESE PAINTS ARE SPECIALLY PREPARED, and are most valuable for protecting and arresting rust on all ironwork, AND WILL COVER TAR EFFECTUALLY; they adhere strongly, acquire great solidity, do not crack, flake off, or blister by heat, and they resist the effects of SULPHUROUS AND GASEOUS EXHALATIONS.

They are used extensively at a large number of GAS-WORKS, on Gasholders, Purifiers, and all classes of Ironwork; also by Government, Railway Companies, &c.

Our CIRCULAR will be forwarded on application. SAMPLE CAN, for trial, sent free of charge.

Works: Brixham, Torbay, Devon,

STEVENS & CO., 21, GREAT WINCHESTER STREET, LONDON, E.C.



IMPROVED GAS APPARATUS,

FOR CITIES, TOWNS, VILLAGES, &c.,

INVENTED AND MANUFACTURED BY

W. C. HOLMES & CO.,

WHITESTONE IRON-WORKS, HUDDERSFIELD.

SOLE MANUFACTURERS of B. W. THURSTON'S IMPROVED SCRUBBER, CONDENSER, and WASHER, in use in many of the principal Gas-Works on the Continent.

PATENTEES of the IMPROVED COMBINED PURIFYING APPARATUS, so eminently adapted for Exportation.

ESTIMATES, PLANS, and SPECIFICATIONS PREPARED for BUILDINGS and APPARATUS.

Prospectus, Price Lists, &c., on application.

LONDON OFFICES—57, GRACECHURCH STREET, CITY.

*** *Please address letters to Huddersfield.*

REFERENCES TO UPWARDS OF 300 GAS-WORKS.

DANIEL HOWARD,

Successor to the late BENJAMIN WHITEHOUSE,

(ESTABLISHED IN 1765,)

BOILER AND GASHOLDER WORKS,

Westbromwich, near Birmingham.

MANUFACTURER OF TELESCOPE AND SINGLE GASHOLDERS,

WROUGHT & CAST IRON TANKS

FOR DITTO,

PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS,

And all kinds of GAS APPARATUS.

Wrought-Iron Roofs, Bridges, and Girders; Steam, Hot Water, and Range Boilers; Tanks, Cisterns, &c.,

And all kinds of Wrought-Iron Work.

DRAWINGS, SPECIFICATIONS, and ESTIMATES FURNISHED.

EDWARD COCKEY & SONS,

ENGINEERS, IRONFOUNDERS, & CONTRACTORS,

FROME SELWOOD, SOMERSETSHIRE

MANUFACTURERS OF

GASHOLDERS, PURIFIERS, CONDENSERS, SCRUBBERS;

ALSO OF

STEAM-ENGINES, EXHAUSTERS, IMPROVED PUMPS FOR TAR AND LIQUOR,

SLIDE-VALVES,

AND ALL DESCRIPTIONS OF APPARATUS USED IN GAS-WORKS.

PATENTEES AND MANUFACTURERS OF THE

DRY-FACED CENTRE-VALVES,

Which are now so extensively used.

During the last year these Valves have been introduced into some of the large gas-works in London, where they are giving the greatest satisfaction. Favourable reports have been received from the engineers of these and of some of the most important works in the kingdom. The demand for them both for home and foreign works continues unabated.

Every Valve is made with covering bars, to protect ALL the faces. The Patentees found the necessity for this almost immediately after they commenced the manufacture of these Valves, and they have ever since adopted the practice. The large experience they have gained has also enabled them to introduce several minor improvements in the construction of their Valves. It is an advantage peculiar to these Valves that the covers can be easily raised, the faces cleaned and oiled, and kept in perfect condition. If managers of gas-works will periodically attend to this, the Valves will be as good after twenty years use as when first put in.

Messrs. COCKEY AND SONS have been very successful in the erection of many gasholders, some of very large size. They erected, in 1871, at Dublin, for the Alliance Gas Company, one of the largest in the kingdom; telescopic, 182 feet 6 inches diameter. It was referred to by the Chairman of that Company the following year, in his report to the shareholders, as having been in use, and working most effectively, since its erection, and being in the highest degree satisfactory to the Company.

Plans of gas-works are carefully prepared, and every improvement which long practical experience can give is introduced into works entrusted to the care of the Advertisers.

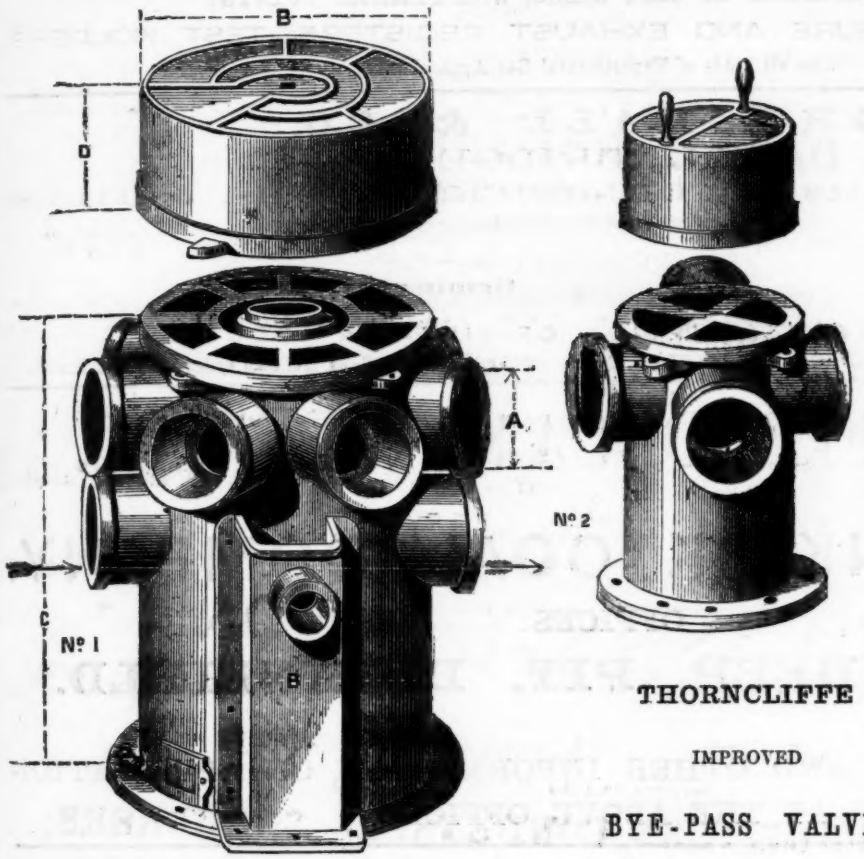
References can be given to the Directors of many Companies who have placed works in their hands, and who will testify to the satisfactory results of so doing.

THE THORNCLIFFE IMPROVED CENTRE-VALVE,

MANUFACTURED BY

MESSRS. NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD.



Sizes of the

THORNCLIFFE IMPROVED CENTRE-VALVE.

		Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
A	Bore of Pipe...	4	5	6	7	8	9	10	12
B	Diam. of Body.	16	20	23	26	28	31	34	40
C	Height of Tank.	33	35	38	43	46	48	51	56
D	Depth of Cover.	8	9	10	11	12	13	14	16
	Total height...	41	44	48	54	58	61	65	72

THORNCLIFFE IMPROVED BYE-PASS VALVE.

SIZES

From 3 ins. upwards.

THORNCLIFFE IMPROVED STOP-VALVE;

SIZES

From 3 ins. upwards.

In all cases the Covers are cast heavy enough to resist any required pressure.

The advantages derived from the adoption of these Valves are so manifest and cardinal that in the immediate character of the change—the simplicity of the machine—the facility affording for cleaning out connexions between Valve and Purifier—the perfect collection and delivery by suitable overflow of the ammonia, at a greatly diminished depth from ground-line over the old form of Valve—the advantage of connecting on the same level, and at any angle, or opposite to each other, the inlet and outlet pipes without dip or rise—the clear acquisition of space in the purifying-house, by being able to place the boxes nearer together, the new Valve being entirely under the floor—and lastly, though of the greatest importance, the passage of crude and unpurified gas during the change is minimized to the merest fraction, thus preventing the fouling by impure gas the delicate machinery and easily affected exposed movements of the station-meter, thereby preventing the introduction of the enemy (unpurified gas) into the gasholder. Also a dead abutment is offered to all back pressure, imparting thereby to the gauges, governors, and hydraulic seals, a steadiness of action never realized with the once famous, but now fast becoming obsolete, Hydraulic Centre-Valve.

N., C., and Co. also Manufacture and Erect

PURIFIERS, CONDENSERS, SCRUBBERS, GASHOLDERS, ROOFS,

And every description of Gas Machinery.

TENDERS GIVEN FOR WORK FIXED COMPLETE IN ANY PART OF THE KINGDOM.

London Office—34, LONDON WALL, MOORGATE STREET, E.C.

FLETCHER AND MURPHY,

GARRATT STREET WORKS, OLDHAM ROAD, MANCHESTER;

Manufacturers of

IMPROVED CONSUMERS WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

AND

IMPROVED DRY GAS-METERS;

STATION-METERS OF ALL SIZES, with PLANED JOINTS;

GOVERNORS, PRESSURE AND EXHAUST REGISTERS, TEST HOLDERS,

And all kinds of Experimental Gas Apparatus.

JOHN HALL & CO.

STOURBRIDGE,

MANUFACTURERS of FIRE-BRICKS, LUMPS, & TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

DUKINFIELD CANNEL COAL.

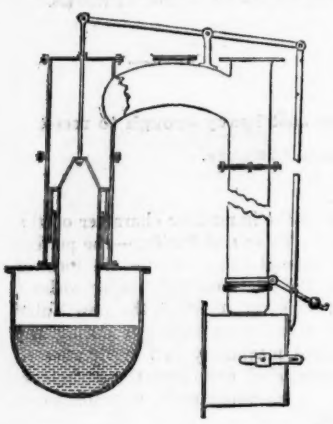
THE DUNKIRK COAL COMPANY.

OFFICES:

ASTLEY DEEP PIT, DUKINFIELD.

ANALYSIS, PRICES, AND OTHER INFORMATION, ON APPLICATION AT THE ABOVE OFFICES.

CHANDLER'S PATENT DIP-PIPE.



It is well known by all Gas Managers that back pressure upon the retorts greatly retards the production of gas, causing a deposit of carbon which keeps steadily accumulating. Such carbon reduces the capacity of the retorts, requires extra fuel for heating, and has to be frequently removed by heavy iron bars, which very much injure the retorts. By the use of Chandler's Patent Dip all these evils are entirely remedied. When the retorts are being drawn and charged, the Dip-Pipe is sealed in the fluid of the hydraulic main. As soon as the lids are replaced, the Dip is raised completely out of the fluid, and the gas passes unrestricted to the holders. By running the exhauster to a level gauge, ALL PRESSURE IS REMOVED FROM THE RETORTS. The consequence is that there is no deposit of carbon, no need of scurfing, no extra fuel is required, a large saving of wear and tear and loss of time is effected, and a greatly increased production of gas per ton of coal is realized.

The manager of the Erith Gas-Works has used the Patent Dip-Pipe to a single retort for some months, with complete success in regard to all the advantages mentioned, and has now ordered the patent to be applied to other retorts. He has kindly consented to reply to any inquiries that may be addressed to him. [See notice in JOURNAL OF GAS LIGHTING, page 413, May 6, 1873.] The Patent Dip-Pipe is also ordered for trial in several other places.

For terms of use and cost, apply only to the Patentees,

Messrs. CHANDLER & SONS, YORK STREET, LONDON ROAD, SOUTHWARK, LONDON, S.E.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

Patents procured for Foreign Countries.

Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 42, Parliament Street, WESTMINSTER.

THOMAS PROUD,

Brookfield Works,

103, ICKNIELD STREET EAST, BIRMINGHAM,

MANUFACTURER OF

WOOD GRIDS

FOR PURIFIERS AND SCRUBBERS,

AND

CONTRACTOR FOR GAS APPARATUS & MAIN-LAYING.

TANGYE BROTHERS & HOLMAN,

10, LAURENCE POUNTNEY LANE, LONDON, E.C.,

SOLE MAKERS OF

MORTON'S PATENT SELF-SEALING RETORT-LIDS,

WITH

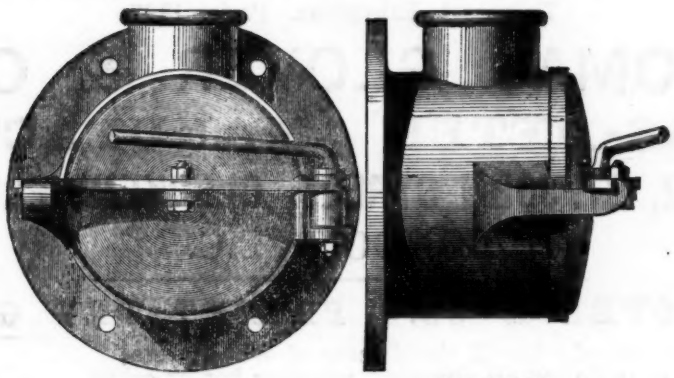
HOLMAN'S PATENT ECCENTRIC FASTENINGS.

OVER 7000 IN USE.

NO LUTING.

LIDS HINGED TO MOUTHPIECES; NO LIFTING ON OR OFF.

NO SCREWS FOR FASTENING.



FRONT VIEW. SIDE VIEW.

SIMPLE.

ECONOMICAL.

DURABLE

EFFECTIVE.

NO DUPLICATE LIDS REQUIRED.

These Lids are proved by many eminent Gas Engineers to be the most efficient, saving much time, labour, and expense; are opened and closed as quickly and with as little trouble as an ordinary furnace door, and by their use the Retorts are soundly sealed during the whole period of carbonization.

THESE LIDS ARE IN USE AT THE FOLLOWING (AMONG MANY OTHER) GAS-WORKS:—

The Gaslight Company, Beckton (where over 2000 are in use).	The Gas-Works, Royal Arsenal, Woolwich.	The Nottingham Gas-Works.
„ Gaslight Company, Bow Common.	„ Alliance and Dublin Gas-Works.	„ Newcastle-on-Tyne Gas-Works.
„ London Gaslight Company.	„ Edinburgh Gas-Works.	„ Carmarthen Gas-Works.
„ Independent Gaslight Company.	„ Manchester Corporation Gas-Works.	„ Merthyr Tydfil Gas-Works.
„ Phœnix Gaslight Company.	„ Salford Corporation Gas-Works.	„ Ystrad Gas-Works.
„ South Metropolitan Gaslight Company.	„ Rochdale Corporation Gas-Works.	„ St. Alban's Gas-Works.
„ West Ham Gas Company.	„ Liverpool United Gas-Works.	„ Over Darwen Gas-Works.
	„ Birkenhead Gas-Works.	„ Aylesbury Gas-Works.

The Morton's Lid is made circular in form, that being the most convenient and suitable shape. It can be used for Retorts of any section, by adapting the Mouthpiece casting from the D, oval, or other shape, at the back, to circular in front.

The following important Testimonial, among others, has been given:—

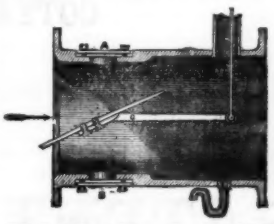
The Gaslight and Coke Company. Engineer's Office, 6, Westminster Chambers, Nov. 14, 1871.

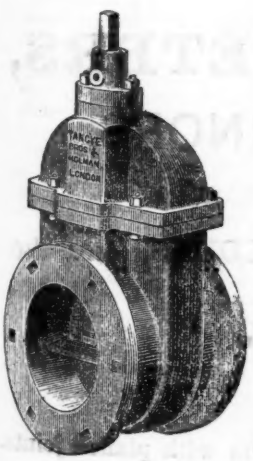
Dear Sir,—In reply to your inquiry, I have the pleasure of stating that the whole of the Mouthpieces at Beckton have Morton's Lids attached to them, and they have given us every satisfaction. We have 2100 in use.—I remain, yours truly, (Signed) F. J. EVANS.

SOLE MAKERS OF

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communication being avoided by placing the Lever or Radius Arm (shown at C on the drawing) inside the Valve-Chamber, upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.





London Gas-Works, Nine Elms, Dec. 25, 1871.

Gentlemen,—The 18-inch Hunt's Patent Throttle-Valve Governor supplied by you to this Company has been in use for about six months, working very satisfactorily; it obviates entirely the oscillation which sometimes occurs with the ordinary Governors, with the annoyance and danger arising therefrom. The efficiency of this Instrument, together with its compactness and lowness of price, ought to ensure its general adoption.

Messrs. Tangye Brothers and Holman. (Signed) ROBERT MORTON, *Engineer.*

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TO CORRESPONDENTS.

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THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 29, 1873.

Notes upon Passing Events.

THE death of Lord Westbury, the arbitrator in the case of the European Life Assurance complications, places the creditors and debtors of that extraordinary swindle in a very embarrassing position. It is a severe and melancholy satire on our legal institutions, that it required an Act of Parliament to give one capable man the power of settling what no one or all the Courts of Justice could have settled in a lifetime. The fact is that, in the complicated condition of modern commercial and financial transactions, we must choose between unlimited delay and dictatorial decrees. When time has become of so much value, anything is cheaper and better than unlimited delay. The cumbrous methods of the law system which Elden practised and approved have been tremendously pruned; but still the game to be run down by the hounds of justice has enormous extent of cover, and a great many earths to fly to. Lord Westbury was a very gifted man—rarely gifted, as a judge, with broad views, fortified by the minutest acquaintance with law in every branch; but there are others whom he has left behind, if not quite so capable, yet very capable, and fit, on occasion, to be created British legal cadis, with ample powers to cut knots that could, in no reasonable time, be untied. The results of Lord Cairns's arbitration are an ample justification of his acceptance of the office of arbitrator. He did ten times more service to commerce and to justice by his awards than by sitting as an additional judge in the House of Lords, if he had been wanted; but he was not. He served his country more as an irregular than as a regular judge, for he stayed ruin and created precedents. We want, as Courts of First Instance, Courts of Conciliation, presided over by men of legal training and hard common sense, to whom all claims involving money payments should be referred before either party plunges into the mysterious wilds of attorneydom.

It is satisfactory to observe that with advancing years Lord Redesdale is losing some of the autocratic power he has so long and so mischievously, and even insolently, exercised in the Private Bill Department in the House of Lords. In respect to gas companies, which he seems to look upon as enemies of the human race, he tried the other day to introduce an amendment, under which companies, whose profits were limited to 10 per cent. in the most prosperous times, would be prevented from raising the rates imposed by Parliament, or lowered in consequence of previous prosperity, to enable them, in disastrous times, to pay at least 5 per cent. Fortunately for the encouragement of private enterprise, the Marquis of Salisbury has a thorough acquaintance with the principles on which joint-stock companies have done so much for the public works of the country, and his Aaron-like rod swallowed up Lord Redesdale's small viper.

While Oxford and Cambridge are yearly bestowing life incomes on clever young gentlemen in the shape of fellowships, which in 90 per cent. of instances prove an encouragement to dilettanteism, if not absolute idleness, an immense machinery had to be set in motion to obtain a pension for an aged scholar, with a very pitiful result.

The following paragraph has been going the rounds of the papers:—

Some short time since, a memorial, originated by the Sussex Educational Association, was forwarded to the Prime Minister, calling his attention to the eminent services of Professor Long to learning and literature. Mr. Long, after a brilliant University career, was elected to a Fellowship at Trinity College, Cambridge, at the early age of 23. He was one of the founders of the London University, and for many years Professor of Latin at University College, and lecturer on Roman law to the Inns of Court. He was editor of the *Penny Cyclopædia*, published by the Society for the Diffusion of Useful Knowledge, and also for many years of the *Journal of Education*. He was the translator of *Antoninus*; was editor of the *Bibliotheca Classica*, and one of the principal contributors to Dr. Smith's well-known Dictionaries of Antiquities, and Ancient Biography, Mythology, and Geography, and for 20 years classical lecturer at Brighton College. In consideration of these facts, and that Mr. Long has, at the age of 73, retired into private life, the memorialists submitted the propriety of a public recognition of Mr. Long's merits by the bestowal of a pension from the Civil List. The memorial was signed by the Earl of Chichester, Lord-Lieutenant of Sussex; by the Bishop of Chichester; by the Duke of Devonshire, Chancellor of the University of Cambridge; by the Vice-Chancellors of Oxford and Cambridge; by the Master of Trinity College, Cambridge; the Master of Balliol College, Oxford; by Mr. Barclay Phillips, Hon. Secretary to the Sussex Educational Association; and also personally supported by Mr. Dodson, late Chairman of Ways and Means.

The result of the petition of all these learned, illustrious, and influential personages has been a pension of £100 (!) a year to a scholar 73 years old—the pension of a duke's butler or coachman.

In spite of covert enemies and jealous friends, decidedly rational education makes progress. Mr. Forster boldly and wisely told some of his captious opponents that "parliamentary legislation was "not conducted on logical principles." The reproach that our Government is a Government of compromise is, in sober truth, a profound compliment. Legislation on logical principles implies not only that one party is entirely in the right, but that to make a road really needed the track must pass in a direct line heedless of the destruction of really valuable obstacles. You must not turn to the right or left a few yards to avoid a school, a hospital, a church, or a dissenting chapel. France is the only country in which any serious attempt has been made to legislate on logical principles, and there parliamentary government has been made impossible. If a majority could be found in the House of Commons to support the views of either Archdeacon Denison or Mr. Dixon and the Birmingham league, ignorance might rule the land unchecked for a century. The archdeacon would have no children educated in State-assisted schools who did not conform to his idea of Church principles, and Mr. Dixon and his friends would like to close every school supported by their hated enemies, the parson and the squire—although ruled by a conscience clause—until the farmers, who, as a body, hate all education, agreed to tax themselves, and establish school boards under their (the farmers) enlightened management. The mining witness who startled a committee the other day by asserting that "the more a man was educated the less inclined he would be for "manual labour," was not far wrong. For mere digging and delving, a human machine can scarcely be too ignorant, if he is well fed, strong, and docile. But the chance of the Sussex farmer's Utopia of a gang of labourers, "strong i' the arm and weak i' the "'ead," has long passed away, and the problem is to make the best of circumstances, and give the most useful education for the district. The educational course of a town mechanic is not that which is most useful to a rural labourer. There is one comfort for the anti-educationists—if we have strikes, we have not living fires, and all the leaven of Internationalism has not produced any semblance of the Cato Street conspiracy.

Mr. Göschen's educational experiment at the Royal Naval School, at Greenwich, seems to have been successful. The poor old fellows who used to be so tormented by their absurd dress and all manner of military regulations have been made happy with comfortable pensions with their relatives and friends, while part of the room they occupied is filled by a regiment of bright boys taught on the best modern system.

No less than 800 boys—the sons of our seamen and marines—who are receiving a good, sound, useful education. They are not only taught seamanship

and trained for the navy, but various handicrafts, by which, if discharged from the service, they may be able to earn a living. At the recent Civil Service competitive examination for honours, where there were as many as 310 competitors from all England, the highest prizes for engineering were won by boys of that school. In other words, out of 14 vacancies for engineers, seven of the boys of this institution took prizes, including the first, second, and third prizes—a thing which had never before been done by any other school.

This is the time of the year when agricultural societies hold their gatherings—fairs they are appropriately called in the United States, for the principal features have long ceased to be those of a museum and place of instruction, where farmers were taught the use of machinery and how to choose live stock, which was all very well 30 or 40 years ago, when in the pre-railway age farmers were still in the bonds of ignorance and prejudice. Now the importance of these shows lies, first, in the business done in sales of both stock and implements; and, secondly, in the opportunity of exchanging ideas in social converse, where agriculturists meet, and combine business and pleasure. But the great gentlemen who hold honorary offices in these societies cannot willingly surrender the old traditions that gave them temporary or local importance. They therefore adhere with childish pertinacity to a prize system, which is completely out of date; at any rate as respects implements and machinery. Of this we have had a recent specimen in the meeting of the Royal Agricultural Society at Hull. It was the turn of ploughs to compete. Forty years ago, with the exception of the old-established factory in Ipswich, ploughs were made chiefly by the village wheelwright and blacksmith. Wooden ploughs were almost universal in England, wheel-ploughs scarcely known, and the use of steel-pointed ploughshares had not commenced. There are now in England alone at least three great factories where iron ploughs of every kind in demand are produced on a wholesale scale, with every assistance that modern scientific tools and machinery can afford. The great firms who had for years divided the trifling prizes awarded at what, in fact, were a series of ploughing matches, came to an understanding not to compete any more—not to go to a great trouble to make sport for the Philistines, and at great expense win prizes that proved nothing. They might have pointed out that the manufacturers of locomotive or of printing machines, or of sewing machines, are not called upon to enter into competition of this kind. At any rate, greatly to the vexation of part of the Council of the Royal Agricultural Society, the firms of Messrs. Ransome, of Ipswich; Messrs. Howard, of Bedford; and Messrs. Hornsby, of Grantham; refused to enter for any of the plough races, leaving the field open to manufacturers of smaller capital and less reputation. The example is likely to spread. Other manufacturers will find out that "the play "is not worth the candles," and decline to spend £500 to win £25. The proper plan would be to revise the whole implement list, follow the example of the Admiralty, which has long given up the system of offering prizes for the best chronometers, and abolish competition for the classes of machines and implements which have become standard, like ploughs, harrows, drills, reaping and threshing machines, and concentrate their efforts in a few considerable money prizes for the reward of important inventive ideas. It is in the incomplete stage that inventors require assistance, not when the idea has become practical and embodied in mechanical facts produced from factories by the thousand. But then such a change would deprive a number of busy, idle gentlemen of the importance to which they have become accustomed as committeemen and stewards.

Another attempt to form a union of the employers of labour, with a view of resisting the powerful combination of trades unions, has been made; previous efforts by single trades to settle a maximum of wages having always failed. The manufacturers did not keep faith with each other. The present idea is a general union, with a council of all trades. The following paragraph appears to have been circulated by authority. The list of the executive council contains some important names, but the great firms of London are conspicuous by their absence—not extraordinary, considering the poor figure the master builders have cut by first proclaiming no surrender and then surrendering unconditionally. *The Times* has suggested that men should be bound not to strike while contracts entered into at a certain rate remain unfinished. The principle appears just, but how is it to work, as no master will bind himself not to discharge a workman paid by the hour, who turns out lazy, drunken, or insolent and disobedient.

An aggregate meeting of the employers of labour was held at the Westminster Palace Hotel, under the chairmanship of Mr. John Robinson, of Messrs. Sharp, Stewart, and Co., Manchester, at which it was resolved to found the National Federation of Associated Employers of Labour, followed by the adoption of the following resolution, proposed by Mr. Anthony Bower, of Liverpool, and seconded by Mr. R. Raynsford Jackson, of Blackburn—viz., "That seeing the perfect organization of the trades unions, their avowed intention of establishing an *imperium in imperio* with a view to dictate the relations of capital and labour, as well as the enormous funds at their command, it is desirable that the efforts of the federation should be vigorously directed to the increase of its dimensions, and thus to the provision of the necessary funds for the promotion of its objects; and that, to this end, this meeting commends to every employer of labour the formation of local and district associations, for the purpose of affiliation to this federation." The object of the federation is explained to be the "promotion and maintenance of such relations between capital and labour as will secure perfect freedom to both, and conduce to the welfare of the whole community." To attain this object, the federation intends—(1) to watch over, with a view to influence, all legislation affecting industrial questions and the relations of employer and employed; (2) to collect and disseminate throughout the country information bearing upon industrial questions; (3) to endeavour to secure the co-operation and unity of action in arranging or resisting demands made by combinations of workmen (so far as such demands may affect the federated trades as a whole), especially by becoming the medium of communication between those trades. The Executive Council of this new society includes Sir Benjamin Whitworth (president), Sir James Ramsden, Barrow; Sir John Savage, Belfast; B. Hannen, London; J. Crossley, Halifax; A. Hanworth, Salford; J. Laird, M.P., Birkenhead; S. A. Marshall, Leeds; W. Malcolmson, Portlaw; J. Robinson, Manchester; W. B. Briggs, Birmingham; Platt (Platt Brothers and Co.), Oldham; Eashworth, Bolton; J. Wilson, Leeds; E. Gilkes, Middlesborough; Titus Salt, Saltaire, Bradford; H. Schneider, Ulverston; W. Morris, Halifax; R. Raynsford Jackson, Blackburn; A. Bower, Liverpool; J. Menelaus, Dowlais; G. Akroyd, M.P., Halifax; Finlay M'Cance, Belfast; Field, London; Vickers, Sheffield; Bennett, London (tailor); Peel, London (bootmaker); Stanley G. Bird, London; Collen Campbell, Potteries; Hatchard, Belfast, &c.

We observe by the report of the meeting of the Middlesex magistrates, that Mr. Kemshead, who was elected chairman about a year ago, as a compliment to his thirty years service as magistrate, has resigned the post, in which a man, however amiable and respectable, should never have been placed when nearly eighty years of age, and as deaf as a post. It may safely be asserted that there is not another institution in the country with grave and important duties to discharge, in which the business is conducted by a majority of once active men, now nearly blind, very deaf, and scarcely capable of articulate speech. In spite of occasional mistakes, the unpaid magistracy of England is a most valuable element in the conduct of public business, which would be expensively and ill supplied by a general diffusion of police magistrates and Government officials through rural England, but in the metropolis the work is so heavy that it is really time that it was placed in the hands of men not much over sixty, and in the full possession of their faculties, and presided over by one of the police magistrates.

GAS COOKING APPARATUS AT THE INTERNATIONAL EXHIBITION.

On a summer's day, a year or two ago, we had occasion to visit the wretchedest slums in Bethnal Green, and in one house we found a man and his wife at dinner. The meal consisted of two penny herrings and a little bread, washed down with some weak tea. The whole cost of the meal—the part, at least, which required cooking—did not exceed 3d. A little inquiry elicited the information that the fuel consumed to broil the herrings and boil the water cost nearly as much as the miserable meal. This fact was brought forcibly to our memory at the International Exhibition, where we saw three mutton chops cooked and a kettle of water boiled by the consumption of 5 cubic feet of gas, costing a little more than a farthing. Poverty and wastefulness of necessity always go together. A straggling grate, in which fuel was burned to the least advantage, and an old iron kettle thickly furred, was what these poor people had at command, and if they had been disposed to be thrifty in the matter of firing they could hardly have succeeded. Straggling grates, however, and kitchen ranges still more wasteful, are to be found in a majority of houses. The Exhibition of the present year will not have been without its use if it only serve to bring more prominently before the public the economy and superiority of cooking by gas. That much interest is felt in the matter is shown by the number of visitors who every day carefully inspect the stoves and ovens, and listen with curiosity to the explanations of the attendants. We cannot here do much more than give a list of the exhibiting firms, and bear a general testimony to the excellency of the manufacture of the articles exhibited. Messrs. Sidney Leoni and Co. show a collection of apparatus for the manufacture of which their firm are justly celebrated. Among these, two attract particular attention—the "Family Kitchener" and the "Family "Cooker." The former, a neat, not to say ornamental structure, would look well in any kitchen, and do all the cooking required by a family of respectable means at a cost which offers a remarkable contrast to that incurred by the poor wretches in Bethnal Green mentioned above. A breakfast for eight, cooked by the consumption of twelve feet of gas, and a dinner for fifteen, consisting of two joints with appropriate vegetables, and a liberal quantity of pastry done to perfection in an hour and a half by the consumption of only 48 feet of gas—that is to say, the two chief meals of the day cooked for less than 4d. when gas is as much as 5s. per 1000—is a fact which should ensure the extensive use of the apparatus. The "Family Cooker," a cheaper apparatus, promises as great economy, the whole cooking required by a family of 12 being done at a cost of 4½d. per day, when gas is 4s. per 1000. Cheaper forms of similar apparatus are exhibited by Messrs. John Wright and Co., of Islington, Birmingham. Their "Round Gas Cooker," No. 67, is admirably adapted for the use of a family of some number, and the economy claimed for it is even greater than that claimed for the above. It is asserted—and from what we saw we do not doubt the assertion—that a dinner, and a liberal one, for twelve can be cooked at a cost of 2d. A very cheap form of the apparatus (No. 69) may be strongly recommended to persons to whom the first outlay is a consideration. The Reflector Gas Cooking Stove, exhibited by the same firm, is another very convenient form of stove, which will be found equally economical. The special recommendation claimed for it is that the joint or poultry is roasted as before an open fire. We are inclined to think that heat is wasted in this form of apparatus, but still we have no doubt of its efficiency and real economy. The same kind of stove (No. 135), of excellent construction, is exhibited by Messrs. Billing and Co., and deserves equal commendation.

We particularize the above forms of cooking apparatus because we believe them to be the best adapted to promote the object we have in view—namely, the extension of the use of gas among the middle classes for other than illuminating purposes. There are, of course, many other inventions of great utility for cooking on a small scale which cost very little money, and would prove very economical. What can be more wasteful than to light a fire in a large grate to boil a kettle of water, or broil a couple of chops, and yet it is done every day at such a season as this. The heat of the fire cannot be endured, and it is allowed to go out, to be rekindled as soon as another kettle of boiling water or a warm flat-iron is wanted. The

waste of fuel in this way is enormous, and all might be saved by the use of some one of the numerous inventions to be seen this year at South Kensington. It is quite within the legitimate business of a gas company to let cooking apparatus for hire, as they have meters. The first cost is the objection which stands in the way of a very extensive use of such inventions, and yet the value of one of the family cookers we have mentioned above, would be saved in a respectable house in the course of one year. The price of one of the best of them is about the cost of 2½ tons of coal at present prices, more than which would probably be saved in one summer.

We have not referred to a great variety of heating apparatus for what may be called industrial purposes, and for warming conservatories. There are many such to be seen at the Exhibition, and all may be pronounced excellent. The "Cheerful" Gas Stove of Messrs. J. Wright and Co. is an admirable invention. It really has a cheerful look, wanting in most gas-stoves, even in those in which asbestos or pumice is heated to redness. And it has the additional recommendation, that it can easily be converted into a cooking-stove on a small but useful scale. In an office or a bed-room it will be found extremely useful, as well as attractive in appearance. Having so recently published the valuable paper of Mr. Hartley, "On Coal Gas as Fuel," in which the economy of gas in dry cooking on a moderate scale is so clearly shown, we need not here go in to that question. We call attention to the Exhibition in the hope that it may assist gas companies in making their mains profitable in the daytime as well as by night, as Mr. Watson put it.

Circular to Gas Companies.

The Government, in the exercise of a wise discretion, have withdrawn the Municipal Corporations (Borough Funds) Amendment Bill. In announcing the intention of the Government, Mr. Secretary Bruce seemed to hint that the Bill might be reintroduced next session. Without pretending to more knowledge than is possessed by any others not in the Government secrets, we may hazard an opinion that the next will be a short and very busy session, and if it be really intended to carry the Bill, it will be introduced early and pressed quickly forward. For this reason we must recommend our readers to be on the alert. The opposition organized this year has been very effective, and we have no doubt that next year an equally powerful array may be formed against a measure as unjust as it is uncalled for.

The Gas and Water-Works Facilities Act (1870) Amendment Bill has, in spite of Lord Redesdale's opposition, gone down to the House of Commons without alteration, and has already made considerable progress in the latter House. The debates in the House of Lords on the second and third readings, of which we give a full report in another place, exhibit Lord Redesdale's fallacies and *animus* in the strongest light. He altogether fails to appreciate the situation of a statutory gas undertaking. He represents it as under the same condition as any other trading speculation. He seems to consider a maximum price fixed by a special Act as a contract entered into by a company, and if a loss be incurred the company must put up with it. But there is no analogy between the cases of a gas company and an ordinary trading speculation. If a company could in prosperous times pay 30, 40, or 50 per cent., or even more, as many trading speculations do, they might be content to incur a loss sometimes, and say nothing about it. But the Legislature has rigorously tied down gas companies to a maximum dividend of 10 per cent.; and when Lord Redesdale thinks "that it is a hard thing that when persons "have taken houses in a district on the faith and in the expectation "that they will be able to carry on their operations with gas at "certain rates," he might remember that persons have invested their money in gas undertakings on the faith and in the expectation that they will get the dividend the Legislature has allowed.

Most opportune at the present moment is the powerful speech delivered by the chairman of the Cambridge Gaslight Company, at the recent half-yearly meeting of the company, which we specially commend to the attention of our readers. The leading proposition put forward is: "That the Legislature has not only deliberately sanc-"tioned the maximum dividends of gas companies as fair and reason-"able profits, but has further shown that it intended to make such "provisions by statute as would enable companies managed with due "skill and economy to realize those profits." In support of this proposition, it was, of course, only necessary to quote the 30th and 31st sections of the Gas-Works Clauses Act, 1847, and the Acts of some metropolitan companies obtained in 1868 and 1869. Nothing can be clearer than the language of the General Act of 1847; and the Acts of 1868 and 1869, providing in the cases of the particular companies, as clearly as if it had been foreseen, for exactly the condition of things which obtains to-day, by supplying the means of raising the price of gas, so that the 10 per cent. might be earned, whatever might be the price of coal. In face of the solemn undertaking of 1847, and the renewed assurance of 1868, the speaker justly remarks that the amended Gas and Water Works Facilities Act, now under consideration, if it should pass in its present form, "will be a retractation by "Parliament of its solemn pledge and decision made after elaborate "and careful investigation, that, in view of the nature of the busi-"ness itself, its capital, its responsibilities, its risks, and its skill, "10 per cent. is a reasonable and not an excessive profit." The speaker goes on to show what will be the practical consequences to the shareholders in his particular undertaking. They have for the most part bought their shares at a price calculated to yield barely more than 5 per cent. if the maximum dividend be paid on the original capital. They have paid this price "on the faith and in the expectation," as Lord Redesdale puts it, that legislative promises would be faithfully kept. But this Bill, if it should pass, will practically confiscate, or rob them of, one-half of their capital. The profit obtained by investing in a risky commercial undertaking will be considerably less than would have been obtained by the purchase of Consols. But this, we may say, is not the worst. There are companies, whose shares have been bought at an equally high price, which cannot pay anything like 5 per cent. on the original capital, and the unfortunate shareholders are infinitely worse off than fundholders. Can there be a more complete answer to Lord Redesdale than is to be found in this speech? He complains that the Bill considers gas producers only, and leaves the interests of consumers out of the question. It may be fairly retorted that his lordship considers consumers only, and altogether overlooks the acknowledged rights and interests of gas producers, who, as the Marquis of Salisbury said, he seems to think should be squeezed of their last farthing. We hope that the speech here referred to, now printed in a pamphlet form, will be freely circulated among members of the House of Commons, and that some member will have the courage to propose amendments in the Bill which will have the effect of bringing its provisions more in accordance with the rights of gas companies repeatedly guaranteed by legislative enactments.

Our readers will remember that in our last we gave a qualified acceptance to the Bill, and we may add that it has been acquiesced in by the Gas and Water Companies Association. Our reasons were, one given at the time, that half a loaf is better than no bread; and another, that the Bill is only a temporary measure. Before it expires we shall be able to form an opinion of the future of the coal market. If high prices should still rule in 1875, another enactment will be necessary, or all the statutory gas companies in the kingdom must go to Parliament for special Acts. It is an encouraging sign that there is a disposition on the part of the Legislature to save us the expense of special Acts. A general Act which would allow gas to be charged for according to the cost of production, as provided for in the Gosport Act, strikes us as the simplest measure to meet the exigencies of the case.

We publish to-day the report of the select committee of the House of Commons on coal. It is not a very remarkable production, and calls but for few observations. Coals are dear, we are told, because there is a great demand for them, and they will continue dear so long as such demand lasts. The hope implied, though not expressed, is that the demand may continue, for it is an indication of great prosperity. But the fact stated, that the demand for iron, which was the chief factor in producing the rise of price in coals, came chiefly from the United States and Germany, suggests that the exceptional wants of these two countries may soon be satisfied, and a fall take place. The paragraph in the report to which we would direct particular attention is the last, which may be quoted with reference to the bill the House of Commons now have under consideration. It is here asserted that "any restraint on the profits of "private business and industry must in justice carry with it the "guarantee of the resources of the State against loss." "High "prices and exceptional profits" can never happen to gas companies restricted in price and dividend, and therefore they may fairly ask not merely for a guarantee against loss, but for the assurance of a reasonable profit.

Continuing our report of the proceedings of the British Association of Gas Managers, we come to-day to Mr. Gore's paper, "On Substi-"tutes for Coal in the Manufacture of Illuminating Gas." Although, so far, the results of all experiments to find an efficient substitute have been purely negative, it is seen how active has been the search for one, and consequently illustrates the risk coal gas companies run of some day finding their industry superseded. We have no immediate fear of this result, but, as said by the chairman of the Cambridge Company, it is a matter deserving consideration when coal gas companies are legislated for. Of recent schemes Mr. Gore tells us nothing which has not already been put before our readers. In the course of the discussion which followed, some experiments on the relatively poisonous properties of coal gas and carbonic oxide were detailed, of which we may briefly say that they are by no means conclusive to our minds of the innocuousness of the latter gas, the rapidly fatal effects of which when inhaled we consider to be incontestably established. It has, we believe, been proved by eminent physiologists that carbonic oxide produces a profound change in the blood which incapacitates it for taking up oxygen—a result which does not follow when coal gas is breathed, unless it contains a large proportion of carbonic oxide. A set of experiments very different from those made by Dr. Louttit are necessary to decide satisfactorily the question of the relatively poisonous qualities of the gases in dispute. Mr. R. H. Jones deserved the vote of thanks for the paper "On "Gasholder Capacity Compared with Consumption," which ought to have provoked more discussion. Probably, however, the remarks of Mr. Hunter expressed the general opinion of the members present. Storeage for 75 per cent. of a day's maximum consumption is no doubt ample under ordinary circumstances.

The West of Scotland Association of Gas Managers deserve a word of encouragement for their efforts to assist each other by an interchange of experience in the conduct of their works. The idea of Mr. Malam of lighting gas in high buildings by means of a sort of Dobereiner's lamp is ingenious. The management of street-mains, treated by Mr. Hall in a most practical manner, is only next in importance to the manufacture of gas; and Mr. Hunter's endeavours to economize purifying materials are entitled to praise, whether he has succeeded or not. We hope it is true that ashes will purify as well as lime, or, at all events, will contribute to the purification of gas.

The accounts of the metropolitan gas companies for the year 1872 were issued on Saturday last. Our usual summary and analysis are in preparation, and will be given as early as possible.

Review.

SANITARY ENGINEERING.*

This is the first of a series of volumes which the author intends to write, to form, when concluded, a complete guide to every branch of sanitary engineering. The present volume treats only of sewerage and house drainage, and leaves very little to be said on those subjects. Mr. Latham is an advocate of the water carriage system, and, therefore, to his mind the works here treated of are the most important it falls to the lot of a sanitary engineer to construct. Accordingly, he gives the fullest information on every step of the work, from the survey of the district to be sewered to the arrangement and ventilation of house-drains and water-closets. The book is admirably illustrated, the smallest and most recent sanitary invention finding a place in the plates, and a full description in the text. We can strongly recommend the book to engineers, who would have to seek in many volumes the information here collected into one.

In saying this we by no means commit ourselves to an agreement with all the opinions expressed by the author, and our praise must be understood to be limited to the purely engineering parts of the work. We are not at all inclined to question the value of sanitary works; on the contrary, on one point—the pre-eminent importance of subsoil drainage—we are in perfect accordance with the author; but with regard to the first table given in his book, showing the results of sanitary works in 12 towns in reducing the rate of mortality, we should have been told what works have been executed.

In London we know that all the sanitary works constructed since 1841 have had no effect on the death-rate, which was practically the same in 1870 as in 1841. We should then be glad to know exactly what has been done at Croydon and at Newport to reduce the rate of mortality 32 per cent. Engineers should not promise too much. The plague has almost disappeared from the earth (it is said, with how much truth we do not know, to prevail occasionally in Persia), but certainly not in consequence of sanitary works. Typhus, is now a comparatively rare disease, but it is the same all over the country, whether there are sanitary works or not. It may sound like rank heresy in these days, but to our minds the connexion of typhoid, or enteric, fever, the worst pest of to-day, with sewer gas or sewage water is by no means satisfactorily proved; and in the dissemination of cholera by a water supply we have no belief at all. But it must not be supposed that we belong to the "dirt party," as it was called some years ago. Without troubling ourselves about the "germs of disease," we may concede at once that pure air, pure water, and last, but not least, sound and sufficient food, are the essential conditions of a healthy existence. The two former, engineering works may help us to obtain; and Mr. Latham will have conferred a benefit on the nation when, by the completion of his work, he has shown how so much may be accomplished.

Correspondence.

A PROBLEM.

SIR,—In your issue of the 1st of July, "Rather Puzzled" puts a very pleasant problem, asking what should be the registration of two gas-meters placed at a difference of level of 100 feet, the same gas being passed through each.

In your next issue, of the 15th of July, W. L. sends a solution of the problem, by giving the registration of two meters placed at a difference of level of 50 feet, being all he could command; and he has made five experiments, commencing at 5 and finishing at 29-10ths pressure.

In the first two experiments W. L. finds the bottom meter to register more gas than the upper meter; but in the next three experiments, which are at higher pressures, the top meter registers most.

"Rather Puzzled" did not say at what pressures the gas was registered in each meter, which, I fancy, has puzzled W. L., for he, finding the pressure on the upper meter higher than on the lower meter, has made his experiments at different pressures, in order, I suppose, to give as much information as possible.

In order to solve the problem, the conditions of pressure at which the gas was registered in each case should have been given, the word *registered* meaning *measured;* because, assuming that both meters presented the same amount of friction, a pressure of 5-10ths at the outlet of the bottom meter would be converted into (roughly) 15-10ths at the outlet of the upper meter, and if pains were taken to regulate the pressure, so as to measure the same amount at both positions, the registration of the two meters would be unequal on account of the gas expanding at the top meter, owing to the lesser pressure of the atmosphere.

I submit that some error has crept into the experiments of W. L., for, if no gas was leaked, the registration of both meters would have borne the same relation one to the other, no matter what the pressure was under which each experiment was conducted, and I would suggest to him to carry the gas down from the upper meter and measure it again at the same level and temperature as it originally passed through the lower meter, in order to see that no gas was lost.

Questions such at this are very interesting, and the pages of the JOURNAL OF GAS LIGHTING might be made very useful in unpuzzling on many points on which, when we meet to discuss, we find differences of opinion, for there can be no two opinions on any matter when both parties are in the right.

Now "Rather Puzzled" may be actually so, or may merely feign to be so; in either case a statement of a fact arising out of the operation of a natural law may be interesting to the readers of the JOURNAL OF GAS LIGHTING.

If you take a closed bladder half filled with air, place it under a receiver and exhaust the air external to the bladder, it will inflate, become full, and may be, burst.

The exhaustion of the atmosphere within the receiver has the same effect as ascending in the atmosphere; it reduces the pressure, and under a reduced pressure the gas expands and measures more than it did under a normal pressure.

Again, an aëronaut never *fills* his balloon, because he knows that a partially filled one will become fully inflated when he gets up, and he provides a valve to let out gas in case his balloon should tend to burst as he ascends.

These two instances show that, other things being the same, the top meter must measure more gas than the bottom meter, and that in this problem there is nothing puzzling when the natural laws are understood.

One interesting fact in connexion with photometry may here be mentioned. Gas photometered at a great elevation, by a meter which is correct at the sea level, will not give so high an illuminating power as the same gas photometered lower down. Why? Because a cubic foot as measured at that altitude is less than a cubic foot at the sea level.

London, July 17, 1873. GEORGE ANDERSON.

GAS COMPANIES ACCOUNTS.

SIR,—Mr. Frith, of Runcorn, by his paper on "Book-Keeping," reported in the JOURNAL OF GAS LIGHTING of July 15, has treated upon a subject which hitherto has not received public notice commensurate with its importance.

The books and accounts of a gas company are of two classes, each class of books being kept with an object quite distinct from that of the other.

The first has reference exclusively to the manufacturing operations of the company, and ought to be so kept as to show in juxtaposition the results of several years working.

The second class of books and accounts have exclusive relation to the financial operations of the company—*i.e.*, to the raising and application of capital, and the further receipts and expenditure with a view to profit.

These books and accounts should be kept so as to show at any time, and with the least expenditure of labour, the exact state of account as between the Company and any of its servants, consumers, or tradesmen; or the state and position of the affairs of the company itself.

All experience applicable to the subject goes to show that all this can only be done by the adoption of the principle of double entry—that every entry made in any account should be balanced by an entry on the opposite side of some other account, or, if needs be, by several entries of lesser sums on several accounts, but so that their total sum shall be exactly equal to the amount of the original entry; but it does not follow that any particular mode of adopting this principle of double entry is the only correct mode; hence various forms of keeping the accounts of gas companies have been devised by authorities who are in every way entitled to respect.

The several books and accounts of the second class should always be opened and kept with reference to the form of balance-sheet, or abstract statement of accounts proposed to be adopted at the periodical balancing of the company's books.

With your permission, I propose in another communication to state what books and accounts I recommend, after 19 years experience as a gas-works manager and company's secretary, are best adapted for the purposes of a gas company, and more especially to submit a form of cash-book, which I think possesses the distinctive merits of enabling the directors of a gas company to ascertain at any time, by simple inspection, the progress made in the collection of the companies accounts, the fidelity of those who are in any way responsible for the safe custody of the company's funds, and also the position of the company's monetary affairs. WILLIAM DORÉ.

4, *Picton Place, Neath, South Wales, July* 25, 1873.

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, JULY 14, 1873.

BRADFORD IMPROVEMENT BILL.—Commons amendments considered, and agreed to.

TUESDAY, JULY 15.

AYR BURGH BILL.—Read third time with the amendments, a further amendment made, bill passed, and sent to the Commons.

GAS AND WATER WORKS FACILITIES ACT, 1870, AMENDMENT BILL.

On the motion for committing this bill,

Lord REDESDALE said: My lords, as I shall not be able to make any remarks in the chair, I wish to offer an observation on the bill at this stage. I think that the measure ought to be confined to cases in which loss is to be prevented, and that it is an improper thing to have a bill passed for the mere purpose of maintaining the dividends of speculative companies by orders of the Board of Trade, afterwards confirmed by Parliament. I confess I think that this is introducing a new principle, and a principle that may prove to be of very serious importance with regard to the transactions of the companies in this country. I should, therefore, desire to see the bill altered so as to run thus—"Where, notwithstanding the exercise of careful economy in manufacture, loss to any undertakers must arise from increase in the cost of the production of gas," and so on; for I do not think that the application of the companies ought to be granted merely for the purpose of keeping up dividends.

Earl COWPER: My lords, I hope that the noble lord will not move any amendment. I do not think that we can expect the companies to go on producing gas unless they can make a profit; and if they give up their operations very great inconvenience will be caused the public. The object of the bill is simply to meet the unprecedented rise in the price of coal, of which your lordships as consumers must be all aware, and which has been of a most unusual character. Five per cent. is not a large dividend. The ordinary dividend of gas companies used to be 10 per cent.

Lord REDESDALE: That was the maximum. The profits of the companies were limited to 10 per cent.

Earl COWPER: I repeat that 5 per cent. is not a large dividend; and I really do not see how we can expect the companies to carry on their works if they are not to make that.

Lord REDESDALE: My objection is to the companies coming here for the mere purpose of maintaining their dividends. Their only claim can be that they are likely to suffer loss, and if they are protected against that, they can surely take their chance for another year; or they can apply to Parliament separately. But here is a power given to a public board to receive applications from any company that can show that it cannot make 5 per cent. at its present rates, and to give them power to raise those rates. I think that that is a most extraordinary proposition.

The Marquis of SALISBURY: My lords, I should like to extract, through the confessional or otherwise, the noble lord's idea of a shareholder. He appears to think that the last farthing should be wrung from him, and that he should be allowed no profit. I think the shareholders in gas companies are placed in a position of some hardship. Their profits have been strictly limited to 10 per cent.; and if they exceeded that amount the surplus was handed over to the public. It seems to me that that fact creates a kind of obligation, that when the state of the case is so entirely changed as has since happened, Parliament shall make a reasonable and fair addition to their rates.

The House then went into committee, and the bill was reported without amendments.

The House having resumed,

Lord REDESDALE said: My lords, in answer to what fell from the noble marquis, I have to say that I do not think that bodies who undertake any business have an absolute right to a fixed dividend. There are hundreds of persons who every year enter into trading speculations in which they find that no profit is to be made; and I think it is a hard thing that when persons have taken houses in a district on the faith and in the expectation that they will be able to carry on their operations with gas at certain rates, power shall be given to the Board of Trade to raise those rates for the purpose of enabling the company to make 5 per cent.

The bill was then ordered to be read a third time on Thursday, July 17.

THURSDAY, JULY 17.

NOTTINGHAM GAS BILL.—Read third time, with the amendments, and passed, and sent to the Commons.

POLLUTION OF RIVERS BILL.—A petition against this bill was presented from the South of Scotland Chamber of Agriculture.

GAS AND WATER WORKS FACILITIES ACT, 1870, AMENDMENT BILL.—Third reading put off till Friday, July 18.

* "Sanitary Engineering; a Guide to the Construction of Works of Sewerage and House Drainage. With Tables for Facilitating the Calculations of the Engineer." By Baldwin Latham, C.E., &c., &c. London: E. and F. N. Spon. 1873.

FRIDAY, JULY 18.

GAS AND WATER WORKS FACILITIES ACT, 1870, AMENDMENT BILL.

This bill having been read a third time,

Lord REDESDALE rose for the purpose of proposing the following amendments:—Clause 7, page 2, line 25, after "where" leave out "with a view to prevent undue loss," and insert "upon proof given that, notwithstanding the exercise of careful economy in the manufacture of gas, loss must arise;" line 26, leave out "arising;" lines 26 and 27, leave out "or to the prevention of undue accumulation of profits by undertakers:" line 28, leave out "appears," and insert "shall appear;" line 38, after "Act" insert "such addition being in the opinion of the board necessary to prevent loss;" page 3, lines 1 and 5, leave out "five" and insert "two." The noble lord said: My lords, I have now to move the amendments of which I have given notice, and which I could not move in committee as I occupied the chair. I consider that this bill goes a great deal too far. I believe the ground upon it is based is on account of the extraordinary price of coal, and it is alleged that many gas companies, unless some provision was made in their favour, would be unable to keep their works going. The bill is to meet a special emergency which may not continue, and you ought to take care not to do anything that may be unjust to the consumer. This bill, however, thinks of nobody but the gas producer. He is to be secured 5 per cent. at the cost of the consumer, and he is himself to bear no loss at all. It seems to me that this ought not to be asked for. It seems to me that application for an order to increase rates ought not to be made to the Board of Trade, except where loss is expected to arise; and then, perhaps, an increase of rates might be properly allowed so as to cover that loss. I think, too, that the increased rates should not be more than would enable the company to divide 2 per cent. I think that that would be amply sufficient to cover any deficiency that might occur. The gas consumers throughout the country feel great alarm with regard to this bill, and in the metropolis very many complaints have been made respecting the Acts which have passed, and which are very unfair to the consumer. It is most unjust that there should be an inflexible dividend of 10 per cent.; and, therefore, I shall ask your lordships to agree to my amendments.

Earl COWPER: My lords, I had hoped that after what was said the other night the noble lord would not again have brought forward these amendments. As I then endeavoured to explain, 5 per cent. is not more than enough. I should consider that only a fair profit, and it should be borne in mind that under ordinary circumstances the companies might have made enormous dividends, but that they were restrained by their Acts of Parliament from doing so. It is, therefore, only fair that they should be allowed such rates as will enable them to earn a small profit. There is one thing that I cannot understand. The noble lord expressed an opinion at an earlier period of the session that certain companies, in consequence of the enormous rise in the price of coal, ought to have the maximum of their rates increased, and yet he now opposes a bill which only allows that maximum to be raised so as to enable the undertakers to divide 5 per cent. Anybody looking at the bill would see that it has embodied the suggestions of my noble friend; and now, upon the third reading of a measure which has been designed to meet his views, and which proceeds upon the ideas which seem to have pervaded the noble lord's mind in framing his resolutions, he brings forward his amendments. One word more. It may, perhaps, not be quite right to grant to the Board of Trade this extraordinary power of making orders; but the fact is that the prosecution of private bills necessarily occupies so much time that it really becomes necessary to allow what is now asked for.

Lord REDESDALE: My lords, I must say I do not think that any answer has been given to any of the objections which I have brought forward against the bill as it stands, and I must say that I think the public have been entirely forgotten as regards this question. The gas companies have a monopoly. It is true that they are restricted by their Acts from dividing more than 10 per cent.; but then other people are restricted by those very Acts from competing with them; and the restricted rates are the terms upon which they have been allowed to enter upon what till now has been a very profitable speculation. I am confident that your lordships will make a very great mistake if you proceed in this way, and if Parliament is to allow any parties who may choose to come forward, increased rates to maintain their dividends to any extent, at the cost of the consumer, who, on his part, is not allowed the benefit of competition. Your lordships should remember that many of these gas-works are carried on in a most expensive manner; and that other companies are selling gas at very much lower rates, and yet are making great profits. Your lordships should also bear in mind the great increase which has taken place in the price of coke and other residual products, and which is enough very nearly to cover the rise in the price of coal. I think that at all events your lordships ought to accept my first proposal, which provides for profit being given, if notwithstanding the exercise of careful economy in the manufacture of gas, loss must arise.

Earl COWPER: I think your lordship will find that that is provided for in clause 7.

Lord REDESDALE: Yes; but the question is not as to the inquiries that are to be made, but as to the ground upon which the application for an order is to proceed.

Earl COWPER: Well, my lords, I trust that the bill will be allowed to pass. We all know that even an unopposed private Act costs between £400 and £500, or at all events a sum which is quite beyond the means of many of these companies; and I can only hope that the bill will again receive the powerful support of the noble lords opposite.

The Duke of RICHMOND: My lords, I may, perhaps, be allowed to express my hope that my noble friend will not press the amendments of which he has given notice. I think he has entirely lost sight of the fact that these companies have not been allowed to charge what they please. They have had maximum rates and a maximum dividend imposed upon them.

Lord REDESDALE: Yes; but they have also had a monopoly.

The Duke of RICHMOND: If they had been in the position of being able to charge what they pleased, and dividing as high dividends as they could make, my noble friend would have had some ground for his opposition. But such a state of things would have been the very reverse of what has been really the fact. The companies have been confined to certain charges by Act of Parliament: and, therefore, now that we have an entirely different state of things—now that coal has risen from 10s. to 20s. a ton, or at all events when the price of coal is double what it was when the existing Acts were passed—it is only fair to give the companies an opportunity of earning half what Parliament in times gone by thought a fair dividend.

Their lordships then divided upon the first amendment given above—

For the amendment	9
Against it	13
Majority against	4

The motion being thus lost, Lord Redesdale did not persevere as regarded the rest, and the bill passed.

MONDAY, JULY 21.

The following bills received the Royal Assent by commission:—

Uxbridge and Hillingdon Gas.
Gosport Gas.
Dumbarton Burgh.
Glasgow Corporation Gas.
Dewsbury & Batley Corporations Gas.
Bradford Improvement.

POLLUTION OF RIVERS BILL.—Report from the Select Committee made, and ordered to be printed. Bill reported, with amendments, and committed to a committee of the whole House on Tuesday, the 29th of July.

TUESDAY, JULY 22.

AYR BURGH BILL.—Returned from the Commons, with the amendments agreed to.

THURSDAY, JULY 24.

MID-LOTHIAN WATER BILL.—Returned from the Commons agreed to, with amendments.

NOTTINGHAM GAS BILL.—Returned from the Commons, with the amendments agreed to.

FRIDAY, JULY 25.

MID-LOTHIAN WATER BILL.—Commons amendments considered and agreed to.

HOUSE OF COMMONS.

MONDAY, JULY 14.

MUNICIPAL CORPORATIONS (BOROUGH FUNDS) BILL.—Petitions for alteration were presented from the Edinburgh Water Trustees, and the Longton Gas Company; in favour, from the Corporations of Swansea, Dover, Wakefield, Derby, Southampton, Romsey, Huddersfield, Exeter, and Poole.

MUNICIPAL CORPORATIONS (BOROUGH FUNDS) BILL.—Second reading deferred till Friday, July 18.

TUESDAY, JULY 15.

MUNICIPAL CORPORATIONS (BOROUGH FUNDS) BILL.—Petitions in favour were presented from Chipping Wycombe, Nottingham, Stalybridge, Edinburgh; and from the Mayor, Aldermen, and Burgesses of Liverpool.

WEDNESDAY, JULY 16.

MUNICIPAL CORPORATIONS (BOROUGH FUNDS) BILL.—Petitions for alteration were presented from the Merthyr Tydvil Gas Company; and in favour, from the Corporation of Wolverhampton.

THURSDAY, JULY 17.

MUNICIPAL CORPORATIONS (BOROUGH FUNDS) BILL.—Petitions in favour were presented from Bolton, Stockport, Flint, Norwich, Scarborough, and Coventry.

FRIDAY, JULY 18.

MID-LOTHIAN WATER BILL (Lords), as amended, considered; to be read a third time.

MONDAY, JULY 21.

AYR BURGH BILL.—Lords amendments agreed to.

GAS AND WATER WORKS FACILITIES ACT, 1870, AMENDMENT BILL (Lords).—Read the first time; to be read a second time, Tuesday, July 22.

MUNICIPAL CORPORATIONS (BOROUGH FUNDS) BILL.—Second reading deferred till Tuesday, July 22.

WATERFORD CORPORATION WATER SUPPLY.

Mr. DELAHUNTY asked the Chancellor of the Exchequer whether, under legislative enactments, the Public Works Loan Commissioners, with the sanction of Her Majesty's Treasury, were enabled to grant loans, bearing interest at 3½ per cent. per annum, to local authorities in England to obtain water supplies for their respective districts; whether the Board of Public Works in Ireland, with the sanction of the Treasury, were enabled to grant similar loans at 4 per cent. per annum to local authorities in Ireland for like purpose; and whether the Treasury had not this year fixed 5 per cent. as the rate to be charged on a loan recommended by the Irish Board to be made to the Municipal Corporation of Waterford for their water supply; and, if so, whether he would state the reasons or motives for charging loans for sanitary purposes in Ireland with a rate of interest nearly 50 per cent. in excess of similar loans in England.

The CHANCELLOR of the EXCHEQUER: I have to answer the first three questions put by the honourable gentleman in the affirmative. As to the fourth question, I may state that we have not the power by law of charging for water-works in Ireland the same interest as is now allowed in England—namely, 3½ per cent. The general rule in such cases is to charge 5 per cent., with a rather long period for the repayment of the principal; but it is in the power of the Treasury to charge 4 per cent. with a shorter period for repayment. After taking the best advice, we thought this was not a case in which we ought to deviate from the ordinary rule.

Mr. DELAHUNTY wished to be informed whether the time for repayment was not 50 years in England, whereas in Ireland it was only 22 years.

The CHANCELLOR of the EXCHEQUER was understood to say that he really did not know.

Mr. DELAHUNTY said that in consequence of the answer of the right honourable gentleman he should on an early day ask whether the Treasury were justified in charging 5 per cent. for loans in Ireland, when they were allowed to lend money on loan at 4 per cent. in England.

TUESDAY, JULY 22.

MUNICIPAL CORPORATIONS (BOROUGH FUNDS) BILL.—Mr. Dimsdale gave notice, on motion for second reading, to move—"That the order be discharged."

NOTTINGHAM GAS BILL.—Lords amendment, agreed to.

MID-LOTHIAN WATER BILL (Lords).—Read third time, with the amendments, and passed.

MUNICIPAL CORPORATIONS (BOROUGH FUNDS) BILL.—A petition for alteration was presented from Plymouth.

GAS AND WATER WORKS FACILITIES, 1870, AMENDMENT BILL (Lords).—Second reading deferred till Thursday, July 24.

MUNICIPAL CORPORATIONS (BOROUGH FUNDS) BILL.

On the order of the day for the second reading of this bill,

Mr. BRUCE said: In the face of the opposition offered to this bill, and considering its great importance, and the interest taken in it by the House generally, I do not think there remains sufficient time for its proper discussion this session, and I propose, therefore, that the order be discharged.

The order was then discharged, and the bill withdrawn.

WEDNESDAY, JULY 23.

POLLUTION OF RIVERS.—A petition for prevention was presented from Carmarthen.

GAS AND WATER WORKS FACILITIES ACT, 1870, AMENDMENT BILL (Lords).—Second reading deferred from Thursday, July 24, till Friday, July 25. Mr. Alderman Lawrence gave notice to move in committee on the bill the following clause:—"This Act, like the principal Act, shall not apply to any place within the metropolis, as the same is defined in 'The Metropolis Management Act, 1855.'"

THURSDAY, JULY 24.

WATERFORD CORPORATION WATER SUPPLY.

Mr. DELAHUNTY moved—"That, in the opinion of this House, the rate of interest upon the loan proposed to be made by the Board of Public Works in Ireland to the Corporation of Waterford for obtaining a water supply for the locality should be fixed by the Treasury at 4 per cent., the enactments under which such loans are granted authorizing them to do so."

The question was put and negatived.

FRIDAY, JULY 25.

GAS AND WATER WORKS FACILITIES ACT, 1870, AMENDMENT BILL (Lords).—A petition against this bill was presented from the Cambridge University and Town Gaslight Company.

GAS AND WATER WORKS FACILITIES ACT, 1870, AMENDMENT BILL (Lords).—Read a second time, and committed for Monday, July 28.

WATERFORD CORPORATION WATER SUPPLY.

Mr. DELAHUNTY asked the Chancellor of the Exchequer, after referring to the last annual report of the Local Government Board of England, wherein, at page 49, it is stated that the board sanctioned loans for sanitary purposes, from August 19, 1871, to December 31, 1871, amounting to £267,562, and from December 31, 1871, to December 31, 1872, to £602,271, making a total of £869,833, whether he would still adhere to his statement that the total amount of sanitary loans sanctioned in England during the said period was only £8693; and, after referring to the annual report of the Commissioners of Public Works in Ireland issued last month, wherein it is stated, at page 7, that the Treasury sanctioned a loan of £50,000 to be made by them, the said commissioners, out of the Public Works Loan Fund of Ireland, to the Waterford Corporation for water supply, whether he would still adhere to his statement that the loan was to be made by the Public Works Loan Commissioners of England.

Mr. BAXTER: My right honourable friend the Chancellor of the Exchequer has asked me to state, in reply to my honourable friend's question, that the amount of the loans sanctioned by the Local Government Board for sanitary purposes, from August 19, 1871, to December 31, 1872, was, as stated in the question, £869,833. The great bulk, however, of this amount was advanced by public companies and private individuals, from whom, until the passing of the Public Health Act of last session, local authorities could borrow on more advantageous terms than from the Public Works Loan Commissioners. The question of yesterday referred to loans made by that board with the sanction of the Treasury, and the amount so advanced was £8389, as stated by the Chancellor of the Exchequer. My right honourable friend fell into a slight inaccuracy when he stated that the £50,000 loan to Waterford was made by the Public Works Loan Commissioners for England. It was made by the Irish board, but the Treasury consulted the English commissioners on the subject.

Legal Intelligence.

HANTS MIDSUMMER ASSIZES.

NISI PRIUS COURT—WEDNESDAY, JULY 16.

(*Before Lord Chief Baron* KELLY.)

FARDELL *v.* THE MAYOR AND CORPORATION OF RYDE.

Mr. COLE, Q.C., Mr. LOPES, Q.C., and Mr. BULLEN appeared for the plaintiff; Mr. KINGDON, Q.C., and Mr. RUSSELL for the defendants.

This was an action to recover the sum of £961 17s. 8d., being the amount of a bill of costs alleged to be due to the plaintiff.

Mr. COLE, in opening the case, said the plaintiff, Mr. Fardell, was a gentleman practising as a solicitor and an attorney at Ryde, and was formerly in partnership with a gentleman named Hearn. He brought this action to recover £961 17s. 8d., the amount of his account against the corporation, for a large variety of business transacted on their behalf; and of that sum, no less than £450 was hard money paid out of pocket for counsel's fees, and other matters connected with the business of the corporation. He would shortly detail to them the way in which the account was incurred. So far back as 1854 Ryde was not a corporate town. At that time an important Act was passed, and under that Act certain commissioners were constituted the governing body of the town. They were vested with important powers, and, among others, that which ultimately became a vexed question in the town—the purchase of some gas-works which then existed at Ryde. They had powers to borrow £23,000 to construct waterworks, and to raise a sum not exceeding £150,000 for the general purposes of the Act. In 1861 the Ryde Water Act was passed, and the commissioners powers were extended by that Act also. In 1859 they adopted the Local Government Act of 1858, and the commissioners therefore became the governing body under that Act. They had power to obtain Provisional Orders, and various works were done under that. In July, 1868, a charter of incorporation was granted to Ryde, which vested all the rights of the commissioners in the new corporation. In January, 1871, the attention of the corporation was called to the fact that under the Ryde Gaslight Act, 1866, the time limited for the purchase of the gas-works by the corporation would expire in the month of June following, and a resolution was passed by the corporation for the appointment of a committee to consider the desirability of purchasing the property of the gas company. In 1866 the Ryde Gas Company, desiring extended powers, applied for a new bill. The corporation resolved to, and did oppose it, and the plaintiff was employed for that purpose. The result was that a clause was inserted in the Act which the company obtained reserving to the corporation the power of purchasing the gas-works; and out of this question the whole of these disputes in Ryde had arisen. The Town Council passed a resolution that it was desirable to purchase the gas-works, and notice to treat was served on the company. A resolution was also passed that Messrs. Hearn and Fardell should be appointed solicitors to the corporation, and act in the purchase of the works. Those gentlemen accordingly took the necessary steps. The requisite notices were prepared and delivered; and the matter was referred to arbitration, Mr. Hunt, the eminent civil engineer of London, being the umpire. Counsel were instructed, and after a sitting of three days in Ryde, and three or four in London, he made his award for the sum of £58,364, which was about £20,000 more than the sum at which the engineers and surveyors of the Town Council had valued the works. This was the origin of the unpleasantness at Ryde. There, however, was the award, and the only thing was to carry it out. The next step was to get the money, and several parties were applied to. It turned out that the Provisional Order which had been made was not sufficient to enable the corporation properly to raise the money. Applications were made to the Secretary of State for a Provisional Order, but one was never obtained. A good deal of litigation took place, and party feeling ran high in Ryde. A ratepayers association was formed, and this association disputed and appealed against the rates which were made. Mr. Fardell was instructed to defend the rates; counsel were instructed; Mr. Fardell had to pay their fees, and heavy costs were incurred. It turned out that the rates were bad in form; but Mr. Fardell had nothing to do with the question whether they were good or bad, he being simply employed to support the rates at the sessions. Matters went on, and a lot of work was done. The engineers who had been employed in giving evidence on the part of the corporation in the arbitration sent in their bills for the services they had rendered. Mr. Fardell was instructed in the matter, and defended an action tried on the Home Circuit. A verdict for the full amount of the gentleman's fees, however, was returned. Then there was a matter with regard to the repair of the sluice, on which Mr. Fardell had to take counsel's opinion. The opinion of Mr. H. Lloyd was taken, and another heavy case, prepared by Mr. Fardell, was laid before a distinguished member of this circuit, Sir John Karslake. Before the old corporation went out of office they passed a resolution by which they undertook to pay Mr. Fardell the costs incurred by him. The latter behaved in the most liberal way towards the new corporation, who were anxious to get all the papers, in order that they might consider them, and decide what was best to be done. He accordingly handed over the whole of the papers in a box. As time went on he was anxious to make out his bill, for though he still held their retainer, and could not therefore take any business against them, he found they had sent business to other firms. But when the application was made for the papers, the corporation said, "No; they are our papers. If you like to come here and inspect them, after giving due notice of the time, you are at liberty to come." Mr. Fardell said that was not quite the way he expected to be treated; that they were his papers; and that they were not entitled to have them until they had paid his account. Mr. Fardell accordingly made out his bill, and sent it in. After waiting more than a month, he applied for payment; but not a shilling was he able to get. He waited a considerable time, and then he discovered that at one of the meetings of the corporation a statement was made that they had been able to settle with all their creditors except Mr. Fardell. They had, however, made no proposition whatever for settlement. Mr. Fardell wrote to the corporation a very proper letter, in which he expressed his willingness to consider any terms that might be proposed. But for two years he had never been paid a single sixpence, although he had paid £450 out of pocket. To the letter he wrote to the corporation there was no reply. He (Mr. Cole) could not congratulate the corporation on the pleas they had put forward. They were, in fact, these:—"Though we employed Mr. Fardell to do this work, and though he has done it, we never ought to have employed him to do it, because we have no power. It was *ultra vires*." He (Mr. Cole) should, however, show that as to the great bulk of the costs which Mr. Fardell had incurred, they were strictly within the limits of their duties as a corporation, though as to some there might be some doubt. They had taken out leave, as it was termed, to plead to this action, and they obtained leave to pay in £197; but they, at length, said they had not the power to pay it in. That was the happy state of this Ryde Corporation. They admitted their liability, and were ready to pay it into court, but they said they had not the money. Well, they must get the money, for they had sufficient powers. With the assistance of the jury, he (Mr. Cole) hoped to obtain a verdict for the full amount, and if there were anything wrong in these charges they might be taxed.

Mr. *Wilson Fardell*, attorney, of Ryde, was called. He said he had sent in his bill of costs, amounting to £1461 17s. 8d. He had received £507 16s. 10d. at various times, of which £7 16s. 10d. had been paid since the action had been brought. The balance now due was £954. The witness put in several retainers from the corporation.

Mr. KINGDON objected that the plaintiff could not prove the seal of the corporation, as he was not an officer of the corporation.

Plaintiff: Yes, I am. I am clerk to the borough magistrate.

Mr. KINGDON was afraid this was as bad law as some other of Mr. Fardell's.

The *Plaintiff*, however, said he knew the seal well, and had seen it.

The retainers were accordingly admitted and read.

The *Plaintiff* said his partner, Mr. Hearn, died on the 18th of October, 1871. A question of the purchase of the gas-works arose, and he received instructions from the town-clerk to carry out the purchase of the works, and copies of notices were handed to them. (Owing to having handed over all his papers to the mayor, he had had much difficulty in preparing his bill.) He gave the necessary notices under the statute, to bring the matter to arbitration. He also had to take counsel's opinion. The corporation appointed one arbitrator to assess the value of the gas-works, and the gas company appointed another. There were also several appeals against rates made by the Ryde Commissioners for general purposes of improvement; and he (the plaintiff) was instructed to support the rate. He was also instructed to prepare a petition against the Ryde Railway Bill; and the result was that a particular clause desired by the corporation was inserted in the bill. He was instructed to obtain a Provisional Order for obtaining land. He was also instructed to defend an action brought by Mr. Knight. He also took Mr. Horace Lloyd's opinion on a question of law relating to the business of the corporation. Sir John Karslake's opinion was also taken on a question relating to the purchase of the gas. Sir John would not give his opinion unless he had 50 guineas on it. He also took counsel's opinion with regard to the rate. The remainder of the items of the bill were explained by the plaintiff, among which was the costs of defending an action brought against the corporation. He sought now to recover £961 17s. 8d. The actual out-of-pocket payments were at least £950 out of the £1400, the amount of his original bill. In November, 1872, he delivered up all the papers to the mayor for the corporation, and he was thanked by the committee for what he had done. His retainer was rescinded by the corporation on the 24th of April, 1873.

At the close of the plaintiff's examination, the JUDGE asked what Mr. Kingdon's objections to these several items were.

Mr. KINGDON: I may state that the evidence is not before your lordship in which most of the objections apply.

The JUDGE: I cannot imagine you can present a case to the jury under any possible circumstances.

Mr. KINGDON said almost the whole of the objections to this account arose out of the purchase of the gas-works, and the legality of the transaction underlay the whole. In the early part of 1871 a negotiation was entered into by the then members of the gas company for the purchase by the corporation of the works. The purchase-money demanded by the company, £61,000, excited a vast amount of ill-feeling among the ratepayers, and a ratepayers association was formed. Meetings were held; and the public indignation reached that pitch that the council who proposed the purchase were obliged to resign, and the present members were elected. They did not object to Mr. Fardell's account as an account, because he had done his work; but the corporation had no funds at their command, either to purchase the gas-works or to discharge this claim. The company had brought an action to enforce the award of £58,000 against the corporation, and when the argument came on during Michaelmas Term in the Court of Queen's Bench all the questions raised in this case would then be discussed.

The JUDGE said all this raised a very important question between the corporation and the gas company; but it was quite a different question between the corporation and their solicitor. He suggested that a verdict should be entered for the plaintiff for the full amount, subject to taxation, if the plaintiff should be entitled to recover, and that Mr. Kingdon have leave to move to enter a nonsuit, or to reduce the damages in respect of any of the class of businesses to which the court should object. When the case came before the court, he suggested that the matter should be referred to the master to report on the bill.

Mr. KINGDON suggested that a special case might be stated.

Mr. COLE said the great objections to that would be the expense and the delay. This gas question only applied to some of the items, but did not underlie the appeals.

Mr. KINGDON: I assure you it does.

Mr. COLE: Suppose the gas had anything to do with it, are not the corporation to have a solicitor to conduct their case, and is he not to be paid?

After some further discussion, in which the judge recommended the statement of a special case, a verdict for the plaintiff for the full amount, subject to taxation, was entered, with leave to Mr. Kingdon to move.

Mr. KINGDON said the corporation cast no reflection on Mr. Fardell, for they believed he had acted fairly; but what they had done was only on behalf of the public interests. They had no private interests, and they only objected to what they believed was not quite legally done by their predecessors.

The JUDGE: I do not hesitate to say that the course now agreed to by the mayor and corporation is highly creditable to them; and while on the one hand they are not desirous of casting the least reflection on Mr. Fardell, Mr. Fardell has nothing to complain of in the line of conduct they have adopted.

BEDFORDSHIRE SUMMER ASSIZES.

NISI PRIUS COURT, WEDNESDAY, JULY 23.

(*Before Baron* BRAMWELL *and a Common Jury.*)

MILLINGTON *v.* THE BIGGLESWADE GAS COMPANY.

Mr. BULWER, Q.C., and Mr. LLOYD appeared for the plaintiff; and Mr. O'MALLEY, Q.C., and Mr. MERRYWETHER, Q.C., for the defendants.

This was an action to recover penalties, under the Act 2 & 3 Wm. IV., c. 70, for the pollution of a well on the premises of the plaintiff. There was also a count for damages resulting from nuisance. The facts were hardly in dispute; indeed, Mr. O'Malley, in opening the defendants case, admitted that the pollution respecting which evidence had been given was caused by the escape of matters from the gas-works. But several points of law were raised, and ultimately a verdict was taken for the plaintiff for £200 on the first count, and 40s. damages on the second, leave being given to the defendants to enter a verdict in their favour.

EDINBURGH COURT OF SESSION (SECOND DIVISION).

FRIDAY, JULY 18.

KELVINSIDE TRUSTEES, *v.* THE PARTICK, HILLHEAD, AND MARYHILL GAS COMPANY, LIMITED.

In this case an action had been brought by the trustees of the Kelvinside Estate against the defendants, who are an unincorporated company, to restrain them from opening up and laying gas-pipes under certain lanes and streets on the property of the plaintiffs, without their consent, and to obtain an order on the defendants compelling them to restore such lanes and streets as they had so opened up to their original state. On the hearing the sheriff granted the interdict craved, but refused the second prayer of the petition because it apparently involved a question of heritable or *quasi* heritable right; and also because the plaintiffs, having lain by and allowed the pipes to be put down, and not having appealed against a previous interlocutor of the sheriff substitute, by which interim interdict was recalled, could not insist upon an alteration in the now existing state and position of the streets so opened up and laid with pipes until the respective rights of parties should have been decided by action of declarator in the Supreme Court. The gas company appealed against this judgment to the Inner House. At the same time the plaintiffs raised an action of declarator, removing interdict, and claiming £1000 damages in the Court of Session, for injury done to their property by the operations of the gas company. Since the record in that action was made up, the gas company began to carry out like operations beyond the point which the sheriff's interlocutor reached, but still in roads within the plaintiffs property. To put a stop to these operations an act of suspension and interdict was brought in the Bill Chamber. After certain procedure in this suspension, the Lord Ordinary (Shand) allowed the parties to make certain alterations in the note of suspension and interdict, and certain other alterations in the answers; and this having been done, refused interim interdict, but passed the note. Shortly thereafter the parties effected a compromise, under which the defendants acknowledged the right of the plaintiffs in the *solum* of their estate, subject only to a right of passage over the roads thereon, for the purpose merely of locomotion, vested in the Road Trustees, and the defendants further agreed to pay down a sum sufficient to cover the plaintiffs expenses in maintaining their rights, and to refer to arbitration the question as to the sum they should pay them for the privilege of carrying their pipes through the Kelvinside Estate, a distance of about a mile and a half.

To-day all the actions in connexion with this matter were taken out of court, in terms of a joint minute, under which the company pay £3500 to the trustees, and all expenses connected with the suit.

RYE BOROUGH BENCH.—MONDAY, JULY 14.

(*Before Mr.* PLOMLEY *and Mr.* STONHAM.)

Mr. *Richard Roper Kelly* appeared in answer to a summons issued against him, at the instance of the local board, for causing a nuisance by the manufacture of sulphate of ammonia on premises adjoining the gas-works. The proceedings originated at the instance of several inhabitants, who presented a requisition to the local board, as the urban sanitary authority, setting forth that there was a building and place used for a process causing an effluvium, situate near the gas-works, in the borough of Rye, within the district of the said urban sanitary authority, which was a nuisance and injurious to the health of the inhabitants of the neighbourhood, and the said defendant was the person by or on whose behalf the said process was carried on.

Evidence having been given in support of the summons, the defendant, who conducted his own case, denied the existence of any greater nuisance at his works than existed in other works of a similar description throughout the kingdom. He also stated that he was about to remove his manufactory.

Mr. PLOMLEY said, from the evidence brought before the bench, there could be no doubt the works were a public nuisance. Although he had not experienced the nuisance himself, he was not surprised at the inhabitants making the complaints. They had brought the matter before the local board, and hoped that steps would be taken to abate the nuisance, but he did not think Mr. Kelly had taken such steps as he ought with regard to the second memorial, as the nuisance still existed, therefore the magistrates were under the necessity of inflicting a penalty of £2, the lowest they could inflict, and £4 12s. 2d. costs.

LORD MAYOR'S COURT, LONDON.

GUILDHALL, FRIDAY, JULY 18.

(*Before Sir* THOMAS CHAMBERS, *Deputy Recorder, and a Special Jury.*)

MILNE *v.* HOLMES.

The plaintiff in this case, a colliery agent, &c., sued for £700, due to him for promoting a gas company for lighting the Petersburg and Viborg quarters of the city of St. Petersburg.

Mr. SALTER and Mr. COX appeared for plaintiff; Mr. KEMP and Mr. CLARE for defendant.

The defendant was to be contractor for the company, which plaintiff had been instrumental in floating. The defendant had differences with the company, which resulted in a Chancery suit. According to the evidence of Mr. Learoyd, who acted as solicitor for the defendant, it was arranged that £2100 should be paid to Mr. Holmes by the company in settlement of their dispute, which sum (less £700 attached in this court by the plaintiff) was actually paid to the Midland Banking Company, the bankers of the defendant. Mr. Mellor, who was engineer to the company, stated that it was expressly stipulated that if this sum was paid, it should include all claims by the present plaintiff in connexion with the above company, and it was accordingly arranged that he was to have £700, the sum he now sought to recover. There are other transactions in dispute between the parties, and the case was stopped by an arrangement for reference to an arbitrator, in whose discretion the costs were left, a verdict for the plaintiff as to the £700 being taken, subject to this reference.

GREENWICH POLICE COURT.

(*Before Mr.* PATTESON.)

LANDLORD'S NEGLECT TO PROVIDE A WATER SUPPLY.

Mr. *Felix Bell*, agent and collector of rents of 17 houses known as Mary Anne's Cottages, Greenwich Marshes, appeared on Tuesday, July 9, to an adjourned summons, at the instance of the Greenwich District Board of Works, charging him with omitting to secure a water supply to such houses.

Mr. SPENCER, solicitor to the District Board, said he was instructed to press for the magistrate's order in this case, as the houses in question were generally each occupied by more than one family. There was no supply of water whatever, and the residents were now using the water in the tidal ditches of the marsh.

The *Defendant* said that a water supply was formerly furnished to the houses by the Kent Water-Works Company, but it had been discontinued on the ground that the water was wasted. Since the last hearing of the summons he had communicated with the company, asking that water should be laid on, and offering to pay for it according to meter. The company, however, had declined to comply with the request. They required that a proper service should be made to each house, and that it should be paid for at the ordiary rate.

Mr. SPENCER stated that it was not compulsory on the company to supply water by meter to blocks of small houses, although water was supplied at larger residences. The reason why the water had been cut off, as alleged by the Kent Company, was that the pipes of the closets were the means of letting the sewage into the company's main supply-pipes.

The *Defendant* said that when he offered to pay the company for the requisite supply by meter, he thought he had offered that which would at once have been accepted. Everything, however, was now ready for such connexion to be effected as he found the company required, and the work should be proceeded with forthwith.

Mr. PATTESON remarked that there should be no delay in such a matter. He allowed a week for the work to be completed.

On Wednesday, the 16th, the case was again brought before the court, when Mr. Hughes, the inspector of nuisances, said the work had partly been proceeded with. A further adjournment of a week was granted, Mr. Bell paying the costs, and undertaking to complete the job with all possible despatch.

Miscellaneous News.

EUROPEAN GAS COMPANY, LIMITED.

The Annual General Meeting of the Shareholders in this Company was held on Wednesday, July 16, at the Offices, 11, Austin Friars, London—WILLIAM WHITE, Esq., in the chair.

The SECRETARY (Mr. H. M'L. Backler) read the notice convening the meeting and the following report of the directors:—

Gentlemen,—Your directors have the satisfaction to present their report on the proceedings of the company during the past year.

Amiens.—At this station the additional cost of coals has been compensated in only a small degree by the slightly improved value of coke, with which peat has continued in sharp competition.

The price of peat fuel is, however, rising gradually, and coke is now readily sold on better terms than could be obtained during the last twelve months.

As a consequence of the growing demand on the resources of these works, additional apparatus have become indispensable.

A new exhauster, engine, and purifiers, also coal stores and accessory buildings, will shortly be erected.

Boulogne-sur-Mer.—Here, as at Amiens, and other establishments of the company, the reduction of profit is more than accounted for by the heavy additional charge incurred for coals. A large increase in the consumption of gas has, however, taken place, and the prospect appears promising.

At the urgent request of the inhabitants, the company's mains have been laid through an adjoining district, extending to Le Portel, for lighting which an exclusive privilege has been obtained, ending at the same time as the Boulogne concession.

Caen.—The gross earnings of this station have been seriously affected by the reduction in price of gas, to which your directors submitted in order to secure the renewal of the concession for a long term of years; but the additional consumption has already proved so satisfactory as to encourage the hope that the former amount of profit will soon be again realized, and ultimately much increased.

The outlay during the present year will be considerable, for new mains, coal storage, additional purifiers, buildings, and various apparatus.

Havre and Suburban Districts.—Supplementary retort-benches are being constructed to manufacture the gas required for the constantly increasing consumption in this town. Other extensions are also needed for the same reason.

Nantes and Suburban Districts.—Your directors are gratified to be able to call attention to an improvement of the returns here, notwithstanding the interruption of lighting caused by the inundations of last year.

This is accounted for partly by the favourable terms on which the supply of coals was obtained under a long standing agreement applicable specially to this station, but mainly by the satisfactory development of the company's business.

The new retort-house is now in progress, and other measures are being taken, not only to prevent damage from future floods, but to extend the works sufficiently to supply the demand for gas likely to arise for some time.

Rouen, Sotteville, and Suburban Districts.—The diminished amount of profits must be attributed to severe competition in the fuel markets, whereby a rise in the average price of coke has been so far rendered impossible.

The receipts from this source were, in fact, less than during the preceding year, and thus no compensation was afforded for the greater cost of coal.

The first instalment of £3240 for purchasing the freehold of this establishment, as reported to the last annual meeting, has been paid.

Summary.—Extra taxes to the amount of nearly £1800 have been charged in the accounts. That a result so nearly approaching that of former years should have been realized, under the most adverse circumstances, affords strong evidence of vigorous activity, and appears to indicate that present prosperity may be maintained, notwithstanding any difficulty which may yet have to be encountered.

The board propose to declare a dividend at the rate of 8 per cent. per annum, together with a bonus of 2 per cent. After providing for this, a balance of £2264 3s. 6d. will remain.

It must be borne in mind that the command of good French gas coals, of which a considerable quantity had been secured previous to the last great rise, enables your directors to await the time when the exorbitant terms exacted from undertakings less favourably situated can no longer be insisted on. Meanwhile, advantage is taken of every turn of the market to make purchases. Many have recently been effected at a considerable reduction.

To carry out such operations successfully, however, sufficient funds should at all times be available, and adequate stocks maintained; for which purpose a large amount of working capital is necessary.

In consequence of these requirements, and the heavy outlay for extension of works, your directors felt that the time had arrived to make a third call of £2 10s. per share on the 12,000 new shares, and thus, in fairness to all concerned, satisfy those shareholders who had long urged the board to do so.

On reviewing all the circumstances affecting the company, your directors feel justified in taking a cheerful view of its future prospects; £7800 of 5½ per cent. debentures cease to maturity on the 1st of July; of this sum £3000 was renewed at 5 per cent., and the remainder paid off.

Your directors regret to announce the resignation of their highly esteemed colleague, Mr. Lewis Cubitt, owing to failing health.

They have filled the vacancy by nominating thereto Mr. Henry Solomon, a large shareholder of great commercial experience.

Mr. Solomon has, since his nomination, visited the stations, and proved his ability to render valuable aid in the direction of the company's affairs.

This appointment is now proposed for confirmation. Notice has been given that two of your directors (William White, Esq., and John Fisher, Esq.), and both auditors (William Jones Lewis, Esq., and George Harrison, Esq.), retire from office at this meeting, but, being eligible, offer themselves for re-election.

The CHAIRMAN: Gentlemen, I feel very great pleasure in meeting you here to-day, especially after you have heard the report which we have had the satisfaction of presenting to you. I am sure that to my own mind—and I think it must be to the mind of every gentleman who has heard it—it is one of the most satisfactory reports which could be presented under the circumstances in which we have been placed. Many other companies have had to reduce their dividends, unless they have been in the position—which we are not—of being able to raise the price of gas to their customers. We have not only maintained our position, but at one of our stations (Caen) we have actually reduced the price of gas something like 16½ per cent.; and I may say, in passing, that

we are able to supply gas at all our French stations on terms as low as any other foreign company, or any similar undertaking. You will readily understand that such results from our working as are pointed out in the report are not obtainable without great care and deep consideration. The coal question has been with us, as it has been with all other gas companies, the greatest trouble during the past year, and nothing but the clearest foresight and rapidity of action could have enabled us to pull through the difficulties of the times so far and so satisfactorily as we have done at present; but, whether we look to the supply of English or French coal, it is certain that all our arrangements, without exception, during the last two years, have proved thoroughly successful. We have steered the company safely through the trying circumstances in which, in common with all other companies depending so much upon the price of coals, we have been placed; our bargains have been well timed, so as to secure the greatest possible amount of advantage, and we have not had to regret a single contract that we have made. The consumption of gas at our several stations is considerably increasing, and, as more gas is required, of course we have necessarily to provide fresh means for manufacturing and storing as well as distributing that gas. Large sums have been expended and still are being expended for this purpose, and these outlays coming simultaneously with the large additional requirements for working capital, left us no alternative but to make a call upon the new shareholders, and I suppose that those gentlemen who have so long blamed us for not taking this course will rally round us now, and heartily approve of the step we resolved on. However, I may say that what we did was done on the principle of what we believed to be strictly right and just to all concerned, and without any regard to extraneous pressure. And I may also add, in passing, that the call was so readily responded to, that I think out of £30,000 there remains this day something like £700 only due upon it, and I think I am right in saying that those who have not paid are principally gentlemen who are abroad, and who will make good their payments in due time. Our late colleague, Mr. Lewis Cubitt, having, much to our regret, resigned his seat at the board through ill health, it became incumbent upon us, according to our regulations, to appoint his successor at once. We anxiously looked through the list of shareholders to find a gentleman who was qualified in all respects to fill the vacant office. Several names were under consideration, and at length we unanimously came to the conclusion that in selecting Mr. Henry Solomon we were acting in the best interests of the company. Mr. Solomon will not retire from this office until the expiration of Mr. Cubitt's period of service, but as a matter of form the appointment is submitted by one of the paragraphs in the report for your consideration to-day, according to precedent under similar circumstances. We attach great importance to a united board, for if that is not secured any vigorous action on the part of the directors or their officers is nearly impossible. In making our appointments and nominations, we have this principally in view, and I trust nothing will ever occur to militate against it, for it is one of the chief means of our continued success. In conclusion, I will only add that my confidence in our future prosperity is unabated. We are doing all in our power to secure it; we are not leaving a stone unturned for that purpose. We are taking means to increase the value of our residual products; indeed, we embrace every chance we have to turn everything into money. No doubt it is possible that in the future difficulties will arise here and there, but we shall endeavour to overcome them to the best of our ability; and as we have succeeded during the last three years in surmounting such gigantic obstacles, my mind is not in the least disturbed by any prospects as to future results. I move—"That the report now read be received and adopted."

Mr. FAWCETT seconded the motion.

Mr. STOKES: I quite endorse all that the chairman has said in reference to the report. I think it is in all respects very satisfactory when we consider the great price which the directors have had to pay for coal. I am only surprised that the report is so favourable. In addition to the increased cost of coal there has been the great advance in the price of iron, which is a very serious consideration in reference to any extensions which have to be made. I think, therefore, under all circumstances, we may heartily congratulate ourselves upon the present position of the company.

Mr. HUGGINS: The chairman has said that the directors were bound at once to fill up the vacancy at the board caused by the retirement of Mr. Cubitt. I think it would be well that we should have the article of association read, under which this appointment was made.

The SECRETARY read the clause.

Mr. HUGGINS: The clause provides that there shall never be less than five directors. The question which occurs to me now is, whether it would not be for the interests of the shareholders to increase the minimum by one or two, so that hereafter the appointment to any vacancy that occurs may be with the shareholders, and not, as it must be now, almost always with the directors. It is true the appointments they make come up before us for confirmation, but it would be a very unpleasant task for any shareholder to raise an objection to the gentleman appointed by the board, unless he knew strong reasons for opposing him. I do not intend to move any resolution on the subject, but suggest the matter for your consideration.

The CHAIRMAN: Do you think it desirable to disturb the present arrangements?

Mr. HUGGINS: I do not propose to disturb the present arrangements. I merely suggest that the board should take into consideration the propriety of altering the Articles of Association in this respect.

A PROPRIETOR: Do the directors contemplate calling up the remaining £2 10s. on the new shares?

The CHAIRMAN: We are in such a position that I can hardly give you an answer to the inquiry. We are trying to eke out our resources, and to make the most of our residual products. We are trying to make everything profitable. But the greatly increased price of coal obliges us to keep double stocks at all our stations, for fear of any break-down or difficulty that may arise, and we hardly know from day to day what money we may require. At present, however, we do not see a prospect of another call being made. If hereafter we do, you may depend upon it we shall employ the money properly, and it will be a benefit to all the shareholders.

Mr. HUGGINS: Have we any power to increase the price of gas?

The CHAIRMAN: No. Our position is this: We have long concessions, extending over 40 or 50 years, and in consideration of these we submit to a fixed price for the gas we supply, whether coals are at 21s. or 51s. a ton.

A SHAREHOLDER: Are you charging your maximum prices?

The CHAIRMAN: Yes.

Mr. BADDELEY: What is our illuminating power?

The SECRETARY: The same as in Paris.

The CHAIRMAN: It is worthy of notice that, amidst all the difficulties through which we have passed, our profits are only £4000 or £5000 less than in the previous year, after having paid £1800 more taxes, and sustained a loss of £1200 by the inundations at Nantes.

The motion was put, and carried unanimously.

The CHAIRMAN: I have now to move—"That a dividend at the rate of 8 per cent. per annum be declared on the old and on the new shares, the first moiety thereof having been paid on the 1st of February; that the second moiety thereof be paid on the 1st of August next, together with a bonus of 4s. per share on the old shares, and 2s. per share on the new shares, the whole out of interest and profits, less the income-tax."

The motion was seconded, and carried unanimously.

Mr. FAWCETT: Gentlemen, I beg to propose a resolution, which I am sure will be gladly accepted by the meeting at large. It is—"That William White, Esq., be re-elected a director of the company." The very long service which our esteemed chairman has rendered us, the interest he takes in all its affairs, his large holding, and I might mention half a dozen other reasons, entitle him to the confidence of the shareholders, and I know he has it. I have, therefore, very much pleasure in proposing his re-election.

Mr. RASCH seconded the motion, which was cordially and unanimously agreed to.

The CHAIRMAN: I thank you for re-electing me a director. This day 25 years ago I was first elected to a seat at the board, the company then being under rather peculiar circumstances. I had been one of those outside men who were very anxious to see whether the company could not be improved. The £20 shares at that time were being currently sold at £8; the shareholders had no dividends, and I felt, as a large holder, having a stake of something like £15,000 in the concern, determined to do something to remedy the unfortunate position of affairs. I believe I may say correctly that from that day to this the shareholders have received their dividends regularly, not always the same amount, but always something. It is very pleasurable to me, after so many years, to meet you on an occasion like this, and to find that the confidence so long reposed in me is reposed in me still. I have now to move—"That John Fisher, Esq., be re-elected a director."

Mr. RASCH seconded the motion, which was put, and carried.

Mr. FISHER returned thanks.

The retiring auditors, Messrs. Lewis and G. Harrison, were also re-elected.

The CHAIRMAN: I beg to move—"That the appointment by the directors of Mr. Henry Solomon to fill the vacancy occasioned by the resignation of Mr. Lewis Cubitt be confirmed, in accordance with clause 73 of the regulations of the company."

The motion was put, and carried unanimously.

Mr. SOLOMON: Gentlemen, I can only say that as you have placed confidence in me by confirming the resolution of the board, every effort on my part will be made to further the interests of the company, and in co-operation with my brother directors I trust we may succeed in maintaining its present prosperity.

Mr. O. B. C. HARRISON: With reference to the suggestion made by an honourable proprietor, that at some future time we should increase the number of our directors, I rise to express my opinion that such a course would be extremely unwise. If at any time in the past the existing arrangements had been found inconvenient, or if the interests of the company had suffered by the number of directors being confined to five, the proposal now made might have been worthy of some consideration. But inasmuch as according to the statement of the chairman, our affairs for the last 25 years have been going on in a prosperous condition, and, notwithstanding the untoward events of the last few years, are still prosperous. I think our policy is to "leave well alone." Having found our present directors to be men of strict integrity and great ability, it would be extremely unwise and impolitic to interfere with the constitution of the company for the sake of adding others to the board. I hope, therefore, the proposition or suggestion will not be entertained, but that we shall go on for many years to come and find our affairs prosper under the same directorate as heretofore.

The CHAIRMAN: If you will allow me on this occasion I am desirous to perform a pleasant duty, and that is to ask you to pass a vote of thanks to our secretary. I believe him to be the most indefatigable secretary that any company ever had. You may have good directors and other officers, but unless you have a good secretary to guide the whole matter you are very likely to go wrong. In our case we have a gentleman who devotes his time and attention most assiduously to every detail of our affairs, and I can assure you that to me, as chairman of the company, it is a pleasure to co-operate with him, because I know I have at my right hand one who will take care that nothing but what will conduce to the efficient working of the company shall take place. I hope you will give him a unanimous vote of thanks to-day for his services.

Mr. HUGGINS: I am sure, sir, that we on this side of the table can bear testimony to the ability and energy of our secretary, and to the courtesy and kindness with which he meets any inquiry for information respecting the company. I feel that in Mr. Backler we have a gentleman who is eminently qualified for the important office which he fills, and I have therefore much pleasure in seconding the vote of thanks to him.

The motion was put, and carried unanimously.

The SECRETARY: Mr. Chairman and gentlemen, I thank you very kindly for the flattering notice you have taken of my services. While appreciating highly, as I do, all that has been said of me, and which I cannot but think is more than I deserve, I should mention how much I am myself indebted to the other officers of the company. If we had not, as we have, an admirable staff abroad—men who, I may say, love their business—we could not achieve the result we do. Some of these gentlemen have been with us many years; they have been educated to our business, and take the same interest in it as if it were their own. I had the pleasure of seeing them all over here last year, and they were enabled to derive such advantage of the experience of English engineers as could be gathered from visiting the London gas-works. No doubt this added a great deal to the efficiency of some of them in enlarging their experience by contact with others. If it were not for the assistance I derive from the staff of the company, and especially from the managers, it would be impossible for me to deserve half the praises which the chairman has been kind enough to bestow upon me. I thank you very much for your expressions of confidence and approval.

On the motion of Mr. STOKES, seconded by Mr. ROAN, thanks were voted to the chairman and directors for their continued attention to the affairs of the company.

The CHAIRMAN, in acknowledging the compliment, said: As the organ of the board, I offer you our thanks for this vote which you have passed in our favour. I can assure you it has not been so easy a time for us during the last two or three years as it was before, but the results show what can be done by constant attention and energetic action. We have been enabled to surmount what I may call gigantic difficulties, and we are now paying you a 10 per cent. dividend, just as though nothing had ever happened. These things cannot be accomplished without a great deal of anxiety and trouble, but your directors have always been willing to take that upon themselves, and they are satisfied with the reward they receive in the approval of the shareholders on these occasions. You may rest assured that in the future we shall look well after your interests, and endeavour to make the best of all our resources.

The proceedings then terminated.

GLASGOW WATER COMMITTEE.—At the monthly meeting on the 14th inst., the report of the engineer (Mr. Gale) as to the state of the works was read. It stated that the late rains have added materially to the quantity of water in store in the lochs, and at present there is 112 days supply. At the Gorbals works the water in store on the 5th inst. was sufficient for 70 days only, and as rain does not affect these works to the same extent as it does the lochs, it is possible that by the end of September the quantity of water drawn from them will have to be reduced. The reservoir at Mugdock contains 17 days supply for the city, or within two days supply of being full. The quantity of water sent into the city and district during April, May, and June last averaged 27,730,000 gallons a day from the Loch Katrine works, and 4,050,000 gallons a day from the Gorbals works; together, 31,780,000 gallons a day, or 670,000 gallons a day less than during the corresponding three months of 1872; but it is 2,130,000 gallons a day more than for the first three months of this year.

CAMBRIDGE UNIVERSITY AND TOWN GASLIGHT COMPANY.

The Ordinary Half-Yearly Meeting of this Company was held at the Offices, Sidney Street, Cambridge, on Monday, July 14—the Rev. Dr. PHELPS, Master of Sidney Sussex College, in the chair.

The SECRETARY (Mr. W. Peed) having read the minutes of the last meeting, which were confirmed, the following report and statements of account were presented:—

The directors submit to the shareholders a statement of accounts for the half year ending Michaelmas, 1873, which accounts have been duly audited.

The profit and loss account shows a balance of £959 19s. on the half year's working.

The directors recommend a dividend for the half year after the rate of £4 per cent. per annum on the consolidated stock, and on the amount paid up on the new shares, payable on the 1st of August next, free of income-tax.

The directors feel bound to make the shareholders aware that even the very moderate balance of profit which this account exhibits is due to the fact that part of the coal carbonized was supplied on old contracts; and that had all the coal carbonized during the past half year been supplied under the existing contract, or at current market prices, not only would no profit have been made, but there would have been a considerable deficit. In other words, the receipts would not have covered the cost of manufacture and distribution. The circumstance that the directors happened to have secured a larger stock of coals than usual, before the price attained its present exorbitant amount, has enabled them to stave off the evil day, but no such resource now remains, and the directors look forward with the greatest anxiety to the result of the working of the coming half year, confident that no profit will be made, but, on the other hand, that all their exertions, coupled with the exercise of the most rigid economy, will not enable them to supply gas except at a very serious loss. The shareholders are aware that the gas is now being supplied at the maximum price fixed by the company's Act to all consumers except the Improvement Commissioners, who even before the great and unprecedented rise in the price of coal, &c., were being supplied at a price which could not, in any sense, be called remunerative. The company have power, it is true, to determine the contract at Midsummer, 1875, by given twelve months notice of their intention so to do, but they can only avail themselves of this power by the forfeiture of a sum of £700, in addition to the serious loss which by that time they will have incurred by the contract.

The prospect of the position in which this state of things will ultimately place the company has been to the directors a source of the greatest anxiety, and the steps to be taken to obtain relief have had their most careful and active consideration. No effort has been wanting on their part to effect this object by urging the indroduction of a general bill applicable to all gas companies similarly placed. The Chairman of Committees of the House of Lords, whom the directors with other companies memorialized for a general measure, declined to interfere, preferring to leave it to "the companies specially aggrieved to come next year with separate bills." The directors, desirous of exhausting every available effort before abandoning the hope of a general measure of relief being obtained, have since memorialized the Board of Trade. In reply to that application a letter has been received stating that the Board of Trade propose to introduce a bill into Parliament to authorize, under certain circumstances, a revision of the maximum price of the gas supplied by companies and local authorities. It is hoped that the bill will meet the case of this company, but should it appear that its provisions will not afford adequate relief, the directors will call a special meeting of the shareholders to consider the propriety of a separate application to Parliament next session for powers to increase the price of gas.

The retiring directors are the Rev. Dr. Phelps and Mr. Charles Balls, who are eligible for re-election.

BALANCE-SHEET FOR HALF YEAR ENDING MIDSUMMER, 1873.

Dr. *Capital.* *Cr.*

Consolidated stock	£37,440	0	0	Expenditure on capital account	£56,589	4 1
New shares—first call of £2 per share on 1872 shares	3,744	0	0			
Ditto—second call on ditto	3,744	0	0			
Ditto—third call of £1 per sh.	1,872	0	0			
Loan: The executors of the late H.R. Evans, Esq., on mortgage	5,000	0	0			
Messrs. Foster's temporary advance	4,300	0	0			
Balance	489	4	1			
	£56,589	4	1		£56,589	4 1

Profit and Loss.

Coal carbonized	£6,884	6	9	Sale of gas and meter rents (less bad debts and allowances, £64 16s. 8d.)	£9,198	4 2
Supervision and labour	1,025	8	2	Fittings—profit (less bad debts, discounts, & allowances, £7 13s. 1d.)	106	15 5
Trade accounts	1,173	14	3	Residual products:		
Distribution:				Sale of coke (less bad debts, discounts, and allowances, £46 13s.)	2,648	12 10
Wages	476	15	11	Sale of tar	134	6 1
Trade Accounts	698	4	0	Ditto sulphate of ammonia	580	13 0
Miscellaneous:				Rents	8	10 3
Directors allowance	150	0	0	Sundries	2	13 6
Salaries	334	0	0			
Collectors commission	138	0	8			
Auditors	10	10	0			
Annuities	76	16	11			
Stationery and printing	54	3	9			
Rent	40	0	0			
Rates and taxes	424	11	5			
Interest	233	3	5			
Balance (half year's profit)	959	19	0			
	£12,679	15	3		£12,679	15 3

General Balance.

Revenue account	£959	19	1	Amount owing for gas	£4,351	0 1
Manager's ditto	300	0	0	Ditto coke	602	1 5
Banker's ditto	1,709	18	0	Ditto fittings	753	16 7
Floating assets, Christmas, '73	£7,688	12	10	Ditto tar	32	9 9
Balnce. of revenue account, Christmas, '72	2,700	18	8	Ditto sulphate of ammonia	247	7 5
	£10,389	11	6	Stock in hand:		
Less dividend, declared Jan. 30, 1873	2,199	12	0	Coals	3,296	16 2
	8,189	19	6	Fittings	461	11 9
Unpaid dividend	32	13	0	Tar	124	16 0
				Meters	833	6 3
				Capital account	489	4 1
	£11,192	9	6		£11,192	9 6

The CHAIRMAN said: Gentlemen, in rising to move that the report of the directors be received and adopted, I think it right, on the present occasion, to depart from my usual practice of limiting myself to answering such questions as arise out of this document. I shall be quite ready to answer any such questions, but it seems to me most desirable that the attention of the shareholders, and indeed of the public in general, should be called to a plain and truthful statement of the actual position of gas companies at the present time. The unprecedented and utterly unforeseen increase in the cost of everything pertaining to the manufacture of gas, viewed in connexion with the Acts of Parliament now in force relating to gas companies, is a subject demanding the most serious consideration. The Acts of Parliament to which I allude are of two kinds—general and special. I shall have to direct your attention presently to one of the former class, but at present I will remind you of the Act obtained by this company in the year 1867—the special Act which regulates all our transactions, whether of manufacture, distribution, or sale. By that Act we are bound to supply gas to all the inhabitants within a defined district who desire to have it. We are liable to heavy penalties if the gas so supplied falls below a certain standard of quality either as regards purity or illuminating power. We are absolutely prohibited from demanding more than 4s. per 1000 cubic feet for our gas, quite irrespective of the cost to us of the materials required in the manufacture. Moreover, we are further prohibited from dividing more than 10 per cent. per annum on a certain part of our capital, and 7 per cent. on the remaining part, as profits of our business. The question which naturally presents itself is, how comes it that the trade in gas has been made subject to these extraordinary conditions, these severe penalties and restrictions? Gas for lighting our houses and streets is only one out of many indispensable articles of daily consumption, such as bread, beer, clothes, &c. The manufacturers of these articles, it is quite certain, regulate their price chiefly by the cost of production. They never would submit to a fixed or limited price for sale, irrespective of the cost of raw materials and labour. This, however, appears to be what has been done by those gas manufacturers who are under special Acts of Parliament. Those who are not under such special Acts—as is the case in many small towns and villages, and in some borough towns where the supply of gas is in the hands of the corporation—are now raising the price of gas to 6s., 8s., and 10s. per 1000 feet, and even higher still, to meet the increased cost of production. What is it then which has induced gas companies to submit to these embarrassing—nay, it may be, ruinous conditions? Pardon me if I seem tedious. It is right that this matter should be made quite clear. It is of universal interest—of deadly interest to those whose savings have been invested in gas shares—of a sufficiently lively interest to the already overburthened local ratepayer—but of absolutely universal interest as a question of common honesty or dishonesty, as a question of straightforwardness or of sharp practice in some quarter or other. The explanation of the actual position of gas companies lies, primarily, in the fact that the supply of gas to a town requires the concession of a power to underlie the whole area of the public thoroughfares with a network of iron mains and pipes of various dimensions, which, by reason of being subject to accidents, stoppages, and decay, require frequent examinations and repairs. Now, this power, without the action of the Legislature, can only be granted by local authorities, and these, having granted, may also revoke it, or may grant it concurrently to as many separate companies as they please. It is, however, palpable that a plurality of such networks of pipes as I have alluded to would be, to say the least, a great public inconvenience. And, moreover, seeing that the processes employed in gas-making are unavoidably more or less offensive, it would be simply a gratuitous disregard of the public comfort to allow the sites where these processes are carried on to be unnecessarily multiplied. To secure themselves, therefore, against local caprice which might suggest the revocation of the power to interfere with the streets, gas companies have thought it wise to obtain the sanction of Parliament. And, although Parliament does not guarantee a monopoly of gas to a company by its special Act, nor deprive the local authorities of the right to grant the necessary powers to any number of separate persons or companies, yet it seems now, for the reasons which I have mentioned, to be universally admitted that, practically, the supply of gas (in such a town as Cambridge, for instance) must be a monopoly. I assume, then, and, in fact, the Legislature has assumed, that gas supply must, to all intents and purposes, be a local monopoly. It is on this ground that the Legislature has undertaken to regulate the gas trade, and it may, I think, be granted that the object which the Legislature has chiefly in view is to secure to the public, in a reasonable degree, the advantages which, in regard to other trades, are ascribed to competition, or, at any rate, to guard the public against the disadvantages which might be expected to be a consequence of the absence of competition. Now in investing money in any ordinary business or manufacture, the capitalist certainly expects to make something more than he would by simply putting his capital out to interest. He knows also that there is no law which forbids him to make 10, or 20, or 50 per cent. on his money, should the circumstances of his business be so favourable as to lead to such profits. Look, for instance, at the publicly proclaimed dividends of the great banks and insurance companies, and the no less well-known enormous profits of many private firms, coalowners, brewers, drapers, and hundreds of other trading associations and enterprising individuals. And this is very properly said to be fair and reasonable because all these are subject to competition. Well, gas-making might also be subject to competition. And if it were, can it be supposed that men would be found to employ their knowledge, their skill, and their fortunes in such a manufacture, if, in spite of competition, they had no chance of availing themselves of favourable circumstances, and making occasionally large profits? Is it likely that if the gas trade were practically open, instead of practically monopolized, the profits of such a trade—a trade demanding large capital, charged with grave responsibilities, beset with risks—the risk of being superseded by some other mode of lighting, and the never absent risk of the destruction, by fire or tempest, of the most costly parts of their apparatus—is it likely, I ask, that the profits of such a business would be limited to 10 per cent.? Is it not certain that the capitalists constituting the members of such a trade would so combine as to secure much larger profits? Is it not still more certain that they would never allow their trade to be menaced with ruin, simply in consequence of the increased cost of production? To commercial men these questions admit of but one answer. They know that capitalists would not embark in such a trade if the chance of large profits were excluded—unless, indeed, they were practically secure of a certain reasonable profit. Now, then, I ask, for whose advantage is it that the gas trade is not an open one? Plainly it is for the advantage of the public. Gas making and gas distribution would be an intolerable nuisance in every town in the kingdom if it were otherwise than a local monopoly. Gas companies go to Parliament, then, to secure the necessary local powers for the exercise of their business, and they rely on the nature of the manufacture and their own honesty of purpose for securing a local monopoly. In consideration of the practical security of these concessions and privileges, the companies submit to have their trade regulated and limited by Acts of Parliament. But we surely have a right to assume that Parliament in thus acting is bound to be equally just to both parties. The gas companies on the one hand and the public on the other have equal claims to the fair consideration of the Legislature. In admitting that, for the comfort and convenience of the community, the trade in gas must not be left free as is the trade in other commodities, but must be regulated in every detail by statute, it is incontrovertible that the statutory terms can only be fairly based upon all the necessary and calculable circumstances of the manufacture—on all that properly relates to the cost of production. It is impossible to deny that the special Acts of gas companies were intended to be so based. The main inquiries of parliamentary committees in framing those Acts related to the cost of production of coal gas. And I presume—nay, I insist—that if the variation in the price of coal had been known to be liable to be doubled or trebled, instead of being confined to certain narrow limits, provision would have been made for enabling the companies to realize such profits as were deemed reasonable, taking full account of the known probable fluctuations in the coal market, whatever those might be. That is to say, either the maximum price of gas would itself have been made subject to change for every change, of not less than a given amount, in the contract price of coals; or some other machinery would have been devised calculated to have the same effect. The gas manufacturer, for the convenience of the public, abandons all chance—nay, I may say, surrenders the absolute certainty—of making very large profits. He may well demand in return what would, practically, amount to a security of such profits as the Legislature, after careful investigation, has deemed reasonable. What is the case with this company? We obtained our special Act in 1867. We encountered the most searching inquiry in committee which an unfriendly opposition could suggest. The circumstances of the coal and iron trade were prominently taken account of in arriving at the statutory terms of the price of gas. Virtually, it must have been assumed that the fluctuations in those trades would not exceed the limits which experience had taught us to look for. And moreover provision had already been made, by a general Act—to which I said before I should have to allude—that the excess of profit in the

more favourable years might go to form a reserve-fund to supply the deficiencies of the less favourable. But now what has happened? The price of coal has advanced beyond all calculation, and the best judges are of opinion that, for a while, the oscillation will be, in relation to the present price, of about the same amount as it has been in relation to the mean price of former years. And, further, there is every probability that the next great permanent change of price will be a still further advance. It is clear, then, that our special Act not only no longer secures to us, but actually prevents us from obtaining the remuneration which we have a right to assume Parliament, by the general Act of 1847, and our special Act of 1867, did not only pronounce to be reasonable, but actually intended to enable us to earn—a remuneration, too, which, I may safely say, we should have been more than able to earn, if we had been free from parliamentary restrictions altogether, even though subject to the competition of rival companies—from which competition, as I said before, Parliament gives us no guarantee. And if Parliament, at those times, pronounced such profits to be reasonable, still more must those profits be deemed reasonable now, when, day by day, a given income, as estimated by its power to procure the necessaries of life, is of less and less value—as is proved by the universal and irresistible demand for increased wages. But I will proceed further, and exhibit to you more exactly and fully the grounds for what I have just advanced—viz., that the Legislature has not only deliberately sanctioned the maximum dividends of gas companies as fair and reasonable profits, but has shown that it intended to make such provisions by statute as would enable companies managed with due skill and economy to realize those profits. In 1847 a general Act was passed, known as the "Gas-Works Clauses Act." In almost all the special Acts which have been passed since that time—and notably in our special Act of 1867—Parliament required that the Gas-Works Clauses Act should be incorporated. Nothing, therefore, could be more deliberately and designedly enacted than the provisions of that general Act, as part of our special Act. Now I refer you to the 30th and 31st sections of the Act of 1847. The 31st section runs as follows:—"The profits to be divided amongst the undertakers in any year shall not exceed 10 per cent. on the paid-up capital in the undertaking, unless a larger dividend be at any time necessary to make up the deficiency of any previous dividend which shall have fallen short of the said yearly rate." What deficiency? Clearly the deficiency from 10 per cent. What can this mean if Parliament did not intend to legislate so as to enable the company to make 10 per cent. profit? Then the 31st section:—"If the clear profits of the undertaking in any year amount to a larger sum than is sufficient, after making up the deficiency in the dividends of any previous year as aforesaid, to make a dividend at the prescribed rate, the excess beyond the sum necessary for such purpose shall from time to time be invested in Government or other securities; and the dividends and interest arising from such securities shall also be invested in the same or like securities, in order that the same may accumulate at compound interest until the fund so formed amounts to one-tenth of the nominal capital of the undertakers, which sum shall form a reserved fund to answer any deficiency which may at any time happen in the amount of divisible profits, or to meet any extraordinary claim or demand which may at any time arise against the undertakers; and if such fund be at any time reduced, it may thereafter be again restored to the said sum, and so from time to time as often as such reduction shall happen." I will just also refer you, if anything further is wanted, to the 34th section, which runs thus: "If in any year the profits of the undertaking divisible amongst the undertakers shall not amount to the prescribed rate, such a sum may be taken from the reserved fund, as with the actual divisible profits of such year will enable the undertakers to make a dividend of the amount aforesaid, and so from time to time as often as the occasion shall require." And then follows a clause providing that in case all the demands alluded to have been satisfied, the dividends paid, and the reserved fund made up to its full amount, and the profits are still in excess of requirements, the rate at which the gas is being charged to the consumer shall be reduced. Now, gentlemen, the Act of 1847, from which I have just quoted, and our Act of 1867 were passed after long and careful investigations by parliamentary committees. And what I am now maintaining as fairly deducible from those Acts may be expressed by the two following propositions:—1. The amount of profit allowed by those Acts must have been deemed the fair and reasonable profit in view of the nature of the manufacture, its capital, its risks, its obligations, and its responsibilities. 2. The limitation of the price of gas could not have been arrived at exclusive of the consideration that the mean price of coals and other materials at the time of passing our Act would, notwithstanding such limitation, admit of the realization of the said approved rate of profit. If these propositions are not true, then the two first recited sections of the Act of 1847—which also, be it remembered, form part of our Act of 1867 by incorporation—are a mockery and a snare. If these propositions are not true, there can be no meaning whatever in the elaborate enactment of the 31st section of the Gas-Works Clauses Act. For that section provides for the adjustment of deficiency and excess of profit, under and over the said approved profit, due, for they could be due to nothing else, to the then known moderate fluctuations in the price of coals and other materials. And the result itself supports my view that this is a true account of the principles and intentions which actuated the Legislature in framing these Acts; and it affords a proof, *pro tanto*, of the accuracy of the calculations on which the terms of price and profit were settled. For we have found, as the average result of our working, that, with the mean price of materials remaining as at the time of the passing of our Act, and with no violent alteration of the law of oscillation about that mean price, we were able to realize the maximum dividends. And if we had not, in our anxiety to prove ourselves alive to the interests of the public as well as to our own, lowered the price of gas from the maximum of 4s. to 3s. 9d., I have no doubt that we should have been able also, in due time, to form the statutory reserved fund. Well, then, if the mean price of coals and other materials at that time had been, as is now the case, double what it actually was, can there be a shadow of a doubt that the statutory limit of the price of gas would have been made higher in due proportion? And is there the slightest ground for believing that Parliament would, in that case, have come to a different conclusion as to what is a fair and reasonable rate of profit? Would Parliament, in case the cost of materials had been double what it was, have therefore concluded that the reasonable and allowable rate of profit should only be the half of what they actually did conclude it ought to be? Will any one, I ask, dare to assert that Parliament meant to lay down such a stultifying proposition as this—viz., that when the mean price of coals is, say, £1 per ton, 10 per cent. shall be considered a fair and reasonable remuneration for gas-making; but that when the mean price of coals is £2 a ton the remuneration shall only be at the rate of 5 per cent.? I confess I can only characterize this as the very perversion of reasoning. It is, at any rate, an entirely new rule in the logic of arithmetic. Yet, strange as it may appear, this rule has been propounded to, and accepted by, the House of Lords! But lest any one should object that the profit which I am claiming as reasonable on the authority of Parliament was so declared by Parliament 26 years ago, and that I have no longer the right to claim for it such an authority now, I reply that this decision of Parliament was repeated by every successive special Act in which the Gas-Works Clauses Act was incorporated, and therefore by our Act 20 years later than that Act. And further still that that decision has been more than confirmed by the most recent legislation on the subject. The Acts of some of the London companies passed in 1868 and 1869 not only sanction such profits, and, in the case of the Chartered Company, allow 10 per cent. on the whole of its enormous capital, but actually make provision, as regards those companies, for this very state of things which has occurred—a provision, namely, that if, with the price so limited, the companies are unable, in consequence of a rise in the cost of materials, to realize the maximum dividends, they shall be enabled to obtain an increase of price sufficient for that purpose by proving their case to arbitrators appointed by the Board of Trade. And these companies have actually availed themselves of this provision, and raised the price of gas accordingly. The fact is that, during the main period of gas legislation, no one seems to have contemplated the possibility of the present state of the coal market; and I regret to have to state that by certain resolutions recently introduced in the House of Lords by the Chairman of Committees, Lord Redesdale, his lordship has utterly ignored the plain view of the case which I have laid before you, and has induced the House, I am sorry to say without any dissentient voice being raised to repudiate, as far as it can be done by a resolution of the hereditary chamber, the plain and incontrovertible intention of the Acts of Parliament to which I have alluded. His lordship's resolution, which I am amazed to find is actually embodied in the 7th clause of a bill now before Parliament, entitled The Gas and Water-Works Facilities Act, 1870, Amendment Bill, is to the effect that no company which shall apply for and obtain the consent of the Legislature to raise the price of gas above its existing statutory maximum—in our case 4s. per 1000 cubic feet—shall, during the time the price remains so raised—and that is so long as the mean price of coal does not fall, and that in my opinion implies an indefinitely long period—be allowed to divide more than 5 per cent. on its capital as profits. This, I say, appears to me to be a repudiation by Lord Redesdale of the plain acknowledgment of Parliament, and, if the bill in its present form passes, will be a retractation by Parliament of its solemn pledge and decision, made after elaborate and careful investigation, that, in view of the nature of the business itself, its capital, its responsibilities, its risks, and its skill, 10 per cent. is a reasonable and not an excessive profit. It is quite plain that this has been the interpretation universally put upon these Acts. For here in Cambridge, and in all other districts, gas shares have constantly sold at prices which can only be justified by that interpretation. And I have no hesitation in saying to you—the present shareholders in this company, to you who have purchased your shares in reliance on the judgment and honour of Parliament, at a price calculated to yield you, when the maximum dividends are paid, barely over 5 per cent. on your investments—I do not hesitate to say to you, that if Parliament, or if the House of Lords, acting on this resolution of Lord Redesdale, takes advantage of this altered state of the coal market—a state of things materially, nay essentially affecting the very basis on which the Gas Acts were framed—takes advantage of this new state of things to retreat from terms of profit which were virtually declared by them to be fair and reasonable, and which, in fact, were barely sufficient to allure capital to the public service in undertakings of undoubted difficulties and risks, I say you will have a right to complain of treatment which I am afraid to designate by its only appropriate epithet. You had a right to believe, in purchasing those shares, that your investment, as long as coal-gas lighting holds its place, would yield you a little over ordinary interest—say 5 per cent. Whereas if Lord Redesdale's resolution is acted upon, and the relief that must be granted by legislation to gas companies is to be based, as in that case it virtually will be, on the consideration that the present mean price of coals and the new statutory maximum price of gas shall just admit of the realization of a profit of 5 per cent., you will find yourselves getting just 2½ per cent. only—considerably less, therefore, than you would have obtained simply by the purchase of Consols. I cannot but think, and I heartily hope it is the case, that Lord Redesdale, in his honest desire to act as the guardian of the interests of the public, has overlooked the real state of the case as it now stands between Parliament and the gas companies. For I cannot bring myself to believe—indeed, it would, in my opinion, be an insult to the Legislature to believe that it considers one of its true and legitimate functions to be to serve the public at the sacrifice of honest private interests and of its own honour. I can imagine, indeed, a somewhat specious argument in favour of Lord Redesdale's resolution, founded on the fact of the shares of gas companies being bought by the public at prices which pay to the purchasers only 5 per cent. The purchasers become thereby members of the gas company, and this may be said to imply that the public are willing to encounter all the risks and responsibilities I have referred to for a remuneration little exceeding 5 per cent. This is a specious but utterly false view of the case. The public make these purchases on the ground of their perfect faith in the proved and established safety of the investment. They consider, and have a right to consider, that the risk was encountered, and that the difficulties were to some extent overcome by the enterprising capitalists who established the works, obtained the necessary concessions and the security practically afforded by legislative enactment: and who certainly would not have embarked their capital on such terms as those now proposed to be introduced by Lord Redesdale. The purchasers of gas shares know that the Legislature, which professes to be the guardian of their property and rights, has induced capitalists to come forward and employ their money in these great public works, by the deliberate declaration that 10 per cent. is the fair and reasonable rate of profit. And they have such faith in that Legislature that they feel they may securely avail themselves of what they reasonably believe to be to them safe investments, at a rate somewhat above the common rate of interest. They know that for this slight advantage they still have to encounter some risk—that, namely, of gas being superseded—but their faith in the law forbids them to have any fear that the law itself will invade their rights. They would think it quite as likely and reasonable that Parliament should pass a bill for reducing the interest on the National Debt from 3 per cent. to 1½ per cent., and leave the aggrieved fundholder to weep over the inevitable and arbitrary reduction of his property in Consols from £92 to £46 for every £100 stock which he holds, as that, on a resolution of a member of one of the branches of the Legislature, the whole property of the country in gas shares should, at one fell swoop, be arbitrarily affected with a similar reduction. It amounts, in fact, to this, that if the bill now before Parliament passes in its present shape, your property is at once and permanently deprived of 50 per cent. of its established market value; for it is vain to speculate on any future return to the prices of materials which prevailed in 1867; such a return is positively out of the range of probability. If it were certain—which I utterly deny—that capital could have been allured into these undertakings under all the restrictions of the gas Acts, and with an absolute prohibition of profit above 5 per cent., then I say that that ought to have been the limit originally settled. To reduce the profit now to such a limit, and simply on the ground that, the cost of production being doubled, the price of the article produced must not be raised in due proportion, is to admit that the former legislation was a snare and a delusion. I have ventured, gentlemen, to address you in this free and outspoken way in hopes of making you so fully acquainted with the circumstances of your position, and that of so many other gas companies, and of so impressing you with the importance of the crisis, that you may, each according to his opportunity, diffuse the knowledge of the same, and more especially may do all you can to bring it to the notice of influential persons, members of the Legislature, and others. I venture to hope also that the local papers will assist us in this appeal to public justice by an ample report of this meeting, and that you will by that means be able to invite to it the attention of your absent friends, by transmitting to them copies of those journals. I have already trespassed at, I fear, unpardonable length on your time and patience. There is, however, yet another part of the subject on which I feel bound to say a few words—I mean the contract which this company is under with the Improvement Commissioners for the public lighting of the streets. This contract dates from Midsummer, 1868. It is for 14 years, but terminable at the end of the first seven years by either party, on giving 12 months notice and forfeiting £700. On these conditions we have this power of bringing this contract to a close at Midsummer, 1875, just

two years from the present time. You all know, but you do not know so well as I do, that the terms of the contract are such as, even under the most favourable prices of materials at the time it was entered into, could not be said to be, in any proper sense, fairly remunerative to the company. It was, however, made, as all parties must admit, with an implied understanding, at any rate, that the cost of the production of gas was the main element on which it ought to be based. No one will maintain for a moment that, even with the strong motives the company then had to conciliate the municipality and to make sacrifices and peace-offerings, such a contract could have been accepted by the directors if there had been the remotest suspicion that in less than five years the price of coals would be permanently doubled. I desire to make as little reference as possible to the state of feeling which at that time existed in the town. The irritation has subsided, and, to judge from my own experience, it is almost obliterated from the minds even of those who were most excited at the time. *Requiescat in pace*—let it remain buried! I cannot but believe that many even of those whom we then considered to be arrayed in hostility against us will be ready to acknowledge that the contract of which I am speaking ought now to be submitted to an amicable revision and reasonable readjustment of terms, in accordance with the altered condition of the coal market; for I cannot believe that there is a single member of the Improvement Board who would be disposed to say with the immortal Shylock,

> If I do catch them once upon the hip,
> I will feed fat the ancient grudge I bear them.

On the contrary, I hope and I believe the Improvement Commissioners, one and all, would feel somewhat uncomfortable with the knowledge that they were exacting the ruinous fulfilment of a contract, based virtually on conditions which are no longer true, and which have really experienced a change which is beyond any conceivable contingency of the contract itself. There is a bill now before Parliament, to which I have already alluded, one of whose objects is to enable gas companies to obtain alterations of their statutory maximum prices of gas. This measure, however, does not, in its present form, affect such a contract as I am speaking of. The commissioners might still be able to

> Crave the law,
> The penalty and forfeit of their bond.

We may, therefore, still be at their mercy, and can only hope that, in their judgment also, power merits its highest attributes, "when mercy seasons justice," and that they will see that, although lawful, it will be anything but just to exact a supply of gas for the next two years on the terms of this contract, and, in addition to so grievous a loss to the company, to demand further the forfeiture of £700 for the permission, even then, to bring it to an end. Thanking you, gentlemen, for the patience with which you have heard me, I now conclude by moving that the report of the directors, &c., be received, adopted, and entered on the minutes.

In answer to Mr. Fetch, the MANAGER (Mr. Wood) stated that there were 800 public lamps, and that the contract price was £1 a quarter for each during the winter months, and 13s. 7d. during the summer months.

Mr. S. PEED seconded the adoption of the reports, and thanked the chairman most heartily for the zeal and ability which he had at all times shown in the interests of the company. The statement which Dr. Phelps had prepared and laid before that meeting showed the position not only of this company, but of all companies throughout the country. The companies should assist each other, and he hoped that if they combined they might obtain a general Act next session to give them the relief the need of which their chairman had so ably pointed out. Gentlemen who knew something of Acts of Parliament must admit that the chairman had displayed great ability in his statement.

Major PEMBERTON heartily endorsed the observations made as to the chairman, and would venture to inquire what steps were the most expedient for them to take in order to check the proceedings in Parliament in reference to the bill named. They all knew what great power Lord Redesdale had in such matters in the House of Lords. He would suggest that their chairman be empowered personally to seek an interview with Lord Redesdale and Mr. Gladstone and Mr. Disraeli, in order that the case might be fairly laid before the Government. He could not but feel confident that Parliament would never pass a bill so utterly subversive of the principle laid down in the bill of 1847, and incorporated in subsequent Acts, acknowledging 10 per cent. to be a fair and reasonable profit. From long experience in official matters himself, he was convinced that half an hour's conversation with gentlemen in their cooler moments, and when not excited by party politics, would have more effect than a long discussion wherein one party was attacked by another.

After some inquiries had been made and answered in reference to the accounts, the motion for the adoption of the report was put and carried.

Major PEMBERTON then proposed that a committee of three, including the chairman, be empowered to seek an interview with Lord Redesdale, Mr. Gladstone, and Mr. Disraeli.

The CHAIRMAN said there could be no objection to a deputation, but he declined being a member of it.

Major PEMBERTON: If the chairman declines to go I shall ask to withdraw my motion.

The CHAIRMAN said they were already in communication with members of both Houses of Parliament, and were doing all they could in the matter. Nevertheless, he did not say that such a deputation might not be desirable if the shareholders wished it, but for many reasons he would rather not be a member of it.

Major PEMBERTON said as the chairman declined to go, he thought the matter should be left in the hands of the directors; but he was, nevertheless, still of the opinion that a personal interview with some of the leading members of both political parties would have a much greater effect than the sending of a statement, however strong and incontrovertible.

After some further conversation the subject dropped. It was agreed that notice be given in the advertisement convening the next meeting to consider the propriety of altering the terms of, or of discontinuing the annuity granted to Mr. Gifford, and that the directors be requested to suspend any payment until the opinion of the meeting has been obtained thereon.

On the motion of Mr. PEED, seconded by Mr. ALLEN, it was resolved that the address of the chairman be printed and circulated extensively throughout the country.

The CHAIRMAN then proposed a dividend for the half year at the rate of 4 per cent., in accordance with the terms of the report of the directors, which was agreed to.

The retiring directors and auditors were re-elected, and the proceedings closed with a vote of thanks to the chairman.

ADVANCES IN THE PRICE OF GAS.—The Huddersfield Town Council on the 16th inst. resolved to increase the price of gas from 3s. 6d. to 3s. 9d. The Portobello and the Musselburgh and Portobello Gas Companies have raised their price to 6s. 8d.; the Kirkcaldy Gas Company from 4s. 4½d. to 6s. 8d.; at Kirremuir there has been an advance from 7s. 11d. to 10s., and at Crieff from 7s. 6d. to 9s. 2d.

SCARCITY OF CANNEL AND GAS COAL.—As evidence of the great difficulty experienced in obtaining cannel, even in the heart of important mining districts, it may be mentioned that Messrs. Ellis Lever & Co., of Manchester, the extensive gas coal contractors, have just sold 5000 tons of cannel from the Derbyshire coal-field to the Wigan Gas Company, Lancashire, similar cannel having been supplied for some time by the same firm to the gas-works at Manchester, Salford, Oldham, Stockport, Ashton-under-Lyne, Macclesfield, &c.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from page* 640.)

WEDNESDAY, JUNE 11.

On the PRESIDENT taking the chair in the afternoon, he stated that the next paper on the *agenda* was one by Mr. Gore (London) on "Substitutes for Coal in the Manufacture of Illuminating Gas." In Mr. Gore's absence, the paper would be read by the secretary.

Mr. G. ANDERSON suggested that the paper should be taken as read, there being no person present to reply to any observations which its reading might elicit.

Mr. R. P. SPICE (London) said he must enter his protest against any paper being "taken as read," and afterwards published. It might be, and he had reason to believe it was in this case a fact, that there were observations of a very damaging kind in a paper so dealt with. If he were correctly informed, the paper of Mr. Gore's contained injurious remarks relating to a modern invention in which he (Mr. Spice) was concerned, and in which parties had invested a quarter of a million of money, and he thought it would be very wrong that those remarks should go before the world, infusing so much poison into the minds of persons connected with gas companies, without the opportunity being afforded to him to furnish the antidote. Without, however, at all entering upon that question at present, he submitted that if the paper was not read it should be withdrawn. He could not allow a paper involving the credit and reputation of persons who were not present to speak for themselves, to appear on the records of the association, without it having been read. If it was read, he should have something to say upon it, and he should at once ask the president to adopt one of two courses—either have the paper read, or direct it to be withdrawn.

The PRESIDENT said he was about to remark, before Mr. Spice spoke, that he quite agreed with Mr. Anderson's proposition as a general rule, but inasmuch as the paper now under discussion contained a description of certain processes which certainly had excited considerable attention among gas proprietors and those having an interest in gas undertakings, the better way on the present occasion (as indeed he had previously suggested to the secretary) was to have the paper read, or at least such portions of it as dealt with those particular processes. Probably those parts of the paper which dealt with other methods and substitutes for coal might be omitted. But he must confess that Mr. Gore having sent in a paper of this importance, it would have been better for him to have made a point of being present, or, if that was not practicable, to have withdrawn his contribution. It was not for him (the president) to do so; it must either be read, or the meeting must deliberately resolve to take it as read, and print it afterwards. Surely, neither the writer nor those who were opposed to the views he represented could sustain any injury by the paper appearing in the records of the association. For his own part, however, he (the president) desired to have it read.

Mr. SPICE said if the paper were not read there would be no opportunity for discussion, and it would go forth to the world with all its errors unanswered, which he thought would be a most dangerous and unjust proceeding.

The question was then put to the meeting, and it was decided that the paper should be read.

The SECRETARY proceeded to read, but

Mr. G. ANDERSON interposed, and submitted that the meeting was going on irregularly. He did not know upon what authority Mr. Spice had made the remarks he had made upon the paper, but for himself he stood there in perfect ignorance of its contents. If Mr. Spice had any corns which were likely to be trodden upon by the publication of this paper, he would have abundant opportunity for retaliation after it was published. He contended that it was a perfect waste of time to read the paper, and that no reason had been adduced why the usual course should not be adopted.

The PRESIDENT said so much of the paper as had been read related to the manufacture of oil gas. Every one present knew about the patent which Taylor had for the manufacture of oil gas, and the manner in which it was carried out. There was nothing new in what Mr. Gore said on this point, and therefore this part of the paper might be passed over in order to come at once to that which related to the modern inventions now exciting so much attention.

Mr. JABEZ CHURCH rose to order, and maintained that the meeting had already decided to have the whole paper read.

The reading of the paper was then continued and finished.

The SECRETARY, in the absence of the writer, read the following paper:—

ON SUBSTITUTES FOR COAL IN THE PRODUCTION OF ILLUMINATING GAS.

By HENRY GORE.

The recent extraordinary advance in the prices of coals used in the manufacture of gas has induced several persons to turn their attention to the possibility of employing other substances than coal for the production of illuminating gas, and within the last 12 or 18 months a number of suggestions have been made, and not a few patents taken out for inventions, each of which claims to have discovered the means by which the desired end may be arrived at. The author of this paper proposes to lay before the members of the association a brief history of what has been accomplished up to the present time in endeavouring to produce illuminating gas from other substances than coal, pointing out in passing what he believes to be the comparative value of the several processes, and also endeavour to give some reasons why such processes have not come into general use.

Before, however, proceeding to describe the various contrivances that have been from time to time brought forward to supersede the use of coal in the production of artificial light, the author would beg to call attention to some conditions which are essential in estimating the value of any substance that is proposed to be employed to furnish light. These conditions may be broadly stated as follows:—

1. That by combustion of the body a sufficient degree of heat be evolved to maintain continuous combustion.

2. That, when the burning body is a solid, it can be easily converted into vapour previous to its complete combustion, as otherwise no flame is generated which is absolutely required for the purpose of illumination.

3. That the burning body evolve in the flame solid matter or very dense vapours, as an essential condition of the illuminating property of the flame.

4. That either the body itself or the raw material from which it is obtainable be present in large quantity and readily accessible.

5. That the products of combustion be gaseous and harmless to the health.

It is a generally known fact that any great accumulation of heat imparts to bodies the property of emitting light. This is more conspicuous in solid and fluid bodies, because their molecules are placed more closely together than is the case in gases and vapours; thus, at a temperature of 1000° Fahr. a solid body becomes red hot, at a little over 1800° white heat or perfect incandescence occurs; but a gaseous body heated to these degrees of temperature would only emit a very feeble light. In order to render a gaseous body luminous during its combustion, it should contain the vapours of some of the higher class of hydrocarbons, and that these, becoming white hot, should yield light. A combustible gas may be used to ignite solid matter accidentally placed within its flame, and thus produce light, as in the case of a coil of platinum wire exposed to the flame of hydrogen gas, or a cylinder of lime or magnesium in the oxy-hydrogen flame; but, as these lights can only be employed under very special circumstances, it is not necessary to include them

in the consideration of the present subject. It is clear that for all practical purposes we can only avail ourselves of such materials for illumination as yield a flame which emits light in consequence of the vapours of heavy hydrocarbons present therein. These hydrocarbons are, indeed, contained in all the substances which are either used for illuminating purposes, or from which illuminating materials are prepared; as, for instance, tallow, palm oil, stearine, wax, spermaceti, paraffin, vegetable and animal oils and fats, mineral and essential oils, coals, shales, or bituminous schists, wood, and resins.

The recent investigations into the character and composition of luminous flames made by Helgard, Kersten, Delville, and Frankland have led to a considerable modification of the views previously held by chemists as to the precise form which the solid material assumes when undergoing complete combustion. Recent observations would lead to the supposition that the particles of carbon are not separated in a solid form as had been previously supposed, but that they are consumed in the shape of very dense vapours at the extreme outer envelope of the flame. This view seems to account for some of the phenomena which are observable when hydrocarbon vapour is burnt under the form of air gas; and has no doubt favoured the use of the more volatile vapours derived from the distillation of petroleum oils.

It would be impossible, within the limits of this paper, to make more than this passing reference to the recent researches relative to luminous flames, but the information to be derived from these researches is unquestionably of very great importance when applied in connexion with certain processes which have recently attracted so much attention—the "air gas" and the "new gas."

The substances from which artificial light has hitherto been derived may be divided into three distinct classes:—

1. Those bodies which are solid at ordinary temperatures, such as tallow, stearine, wax, paraffin, and spermaceti.

2. Fluid substances capable of burning in lamps, such as animal and vegetable oils, camphine or other form of essential oil, and the several varieties of mineral oils, or petroleum.

3. Gaseous substances, derived directly from the destructive distillation of coals, bituminous schists, peat, wood, resin, animal and vegetable oils, fats, and crude mineral oils; or by secondary processes, such as the so-called water gas obtained by passing steam over red-hot metal or charcoal, and then bringing the resultant gases in contact with substances rich in hydrocarbons; or, in another way, by passing currents of more or less dry atmospheric air over the surfaces of highly volatile hydrocarbon compounds, as in the case of the various forms of air gas.

The chemical constitution of illuminating gas may be stated to consist of three primary sets of compounds. We discard for the present purpose the impurities that are present in greater or less quantities in all gases derived from destructive distillation. First we have the luminous gases, next we have the hydrocarbon vapours, and then we have the diluents, or, as the German chemists very appropriately call them, the *light-bearers*. The substances, therefore, best adapted for the production of illuminating gas are unquestionably those in which the elements just mentioned exist in the proper proportion, and hence the value of cannel coal as a gas-producing material. Next to cannel coal come the several varieties of bituminous coal, and of substances other than coal. The oils, fats, and resins rank first, as being best suited for the generation of gas by destructive distillation; then we may take wood, peat, and vegetable refuse as substances capable of producing gas, but of inferior value, from the deficiency of luminous gas or hydrocarbon vapours.

Taking the substances in the order in which we have placed them, those which must first claim our attention are the oils and resins. The former seem to have attracted the attention of experimenters at a very early period in the history of gas illumination, for, by referring to the records of the Patent Office, it is found that allusion is made to the generation of gas from oil so early as 1811. In 1815, Mr. Taylor, of the firm of Taylor and Martineau, obtained a patent for manufacturing gas from oil, and under modifications of this patent, gas-works were in operation at Bristol, Hull, London, Liverpool, Colchester, Dublin, and in several towns on the Continent. In conducting the process an iron retort was set over an ordinary furnace, by which it was to be heated. The retort was partially filled with fragments of brick, pumice-stone, or hard coke; above the retort was placed an horizontal cylinder or reservoir, or other suitable vessel, to contain the oil, and at the same time serve as an intermediate receiver for the gas and other products of distillation. The oil was made to trickle into the heated retort through a small tube near the front. Coming in contact with the heated surfaces of the bricks placed therein, a portion was speedily converted into gas or vapours; these latter, as they had to traverse the entire length of the retort, became in their turn converted into gas. This gas, together with any undecomposed matter, then passed into the oil cylinder through a pipe at the back of the retort. The permanent gas, passing afterwards through the cooling apparatus, and then to the gasholder, the undecomposed oil, vapours, and tar remained in the cylinder, and mixing with the oil, were again conveyed to the retort, and thus the process continued until nearly the whole of the materials were converted into illuminating gas. A gallon of oil yields about 110 cubic feet of gas of a specific gravity of not not quite 700. The illuminating power of oil gas varies considerably, depending in a great measure on the temperature to which the retorts are heated. The author had occasion to use oil as a substitute for cannel for some considerable time, and he found the heat which gave the best results was what would be called a dull heat in a coal gas-work. Owing to the unprecedented increase in the price of coals for export, it is very possible that oil will be substituted for coal in many gas-works on the Continent, particularly in the olive-growing districts of Spain and Italy, the refuse from the oil-presses making very excellent gas.

About the time that Taylor was engaged upon his experiments with oil, other parties were turning their attention to resin as a material from which illuminating gas might be made; several companies were formed and works erected, both in this country and abroad, especially in the United States and Canada. Resin has been employed as a source of illuminating gas in a variety of processes, but the author will confine his remarks to two—one in which the resin is subject to simple dry distillation in an ordinary retort, and the second, where resin is employed to enrich feebly luminous gases. Under the first type the apparatus employed was originally invented by the late Professor Daniel, for the Resin Gas-Works, at Bow. In an ordinary oven two circular retorts are placed, so as to be heated by the furnace below. These retorts pass through the oven, and are open at both ends. The front end of each retort is bolted to a plate, the end of the mouthpiece passing through this plate, and is closed by an ordinary lid, cottar, and cross-bar screws. Flush with the outer edge of the mouthpiece an iron frame is fixed, fitted with a pair of sliding doors. The frame and doors leave a space of about 6 inches between them and the brickwork of the oven. On the top of the oven, and immediately over the retorts, a tank or cistern is placed, and under the bottom of this cistern the heat from the oven is conducted on its way to the chimney. The back end of the retort extends about 9 inches beyond the wall of the oven, and to this end of the retort is attached a flanged mouthpiece, but the exit-pipe for the gas, instead of ascending as in coal-gas retorts, descends and communicates with a tank or cistern by means of a dip-pipe. This vessel occupies the place of the ordinary hydraulic main, the gas being conveyed from it through the coolers or condensers to the gasholder. There is no necessity for using purifiers with resin gas. The mode of working the apparatus is somewhat as follows:—The retorts being heated to a good cherry red, the resin, broken into small pieces, is placed on a perforated shelf, which occupies the upper part of the cistern placed above the retorts. The heat derived from the bottom of the cistern melts the resin, and it passes in a fluid state through the perforated shelf or sieve, and is allowed to flow down the two syphon tubes that are attached to the mouthpieces of the retorts, and placed within the enclosed space formed by the frame and sliding doors. The liquid resin passes into the retort by means of a slightly inclined trough or channel, and is thus made to fall on the surface of the red-hot lumps of fire-brick with which the retort is partially filled. The vapours given off by the liquid coming in contact with the heated surfaces pass along the whole length of the retort, and a large portion of them are converted into permanent gas. The undecomposed vapour passes along with the gas into the cistern or reservoir by means of the descending pipe, from whence the permanent gas escapes to the gasholder, the residual vapours remaining behind in the shape of what is known as resin oil, which is pumped back into the resin cistern, where it acts as a partial solvent of the solid resin. In France and the United States, where resin gas has been more extensively employed than in this country, an apparatus, invented by a French engineer, named Chaussenot, has been worked with great success. It is more complicated than the one just described.

In 1867 the author was engaged in constructing works for the supply of gas to the city of Mexico. The original design for the works contemplated the use of coal, but the non-completion of the railway between the city and the seaport of Vera Cruz rendered it next to impossible to obtain a supply of coal at any reasonable price. The cost of land carriage between the port and the city being at the rate of 100 dollars, or £20 per ton. To meet the difficulties thus raised, an apparatus was designed by the author, in which either wood or water gas could be made and rendered of sufficient illuminating power by combining with it a portion of gas made from resin, or the mineral pitch called by the natives "chapapote," deposits of which occur in Sucatan and on the Isthmus of Tehuantefoce. The retorts were set over an arched furnace in the usual manner, with the exception that the area of the furnace was much larger, it being necessary to use wood for fuel. The retorts were circular, 13 inches in diameter, and 9 feet 6 inches long, open at both ends. At the front end they were fitted with mouthpieces and lids, but instead of ascension-pipes, the two lower retorts were connected by short elbow-pipes to the mouthpiece of the centre retort. On the top of the oven, and immediately over the centre retort, was placed a small iron tank for melting the resin, or holding crude petroleum oil. The back ends of the retorts were fitted with mouthpieces, the two lower ones having ordinary lids, with screws and cross-bars. The upper retort mouthpiece was closed by a flanged cover, to which was bolted a flange bend and pipe for the purpose of conveying the gas to the receiver or hydraulic main placed below the floor of the retort-house. In working the apparatus for wood gas, the two lower retorts were charged with a species of resinous pine called by the natives "Ocote." It is obtained by splitting up the stumps and roots of the pine trees after the main portion of the trunk has been cut down. (This wood yields about 11,000 feet of gas to the 20 Spanish quintals, equal to 2080 lbs. English, if carbonized at a bright red heat.) The gas from the two lower retorts was conveyed into the upper retort by means of the two elbow-pipes, where it underwent a further decomposition. It then escaped to the purifiers, and the illuminating power would average about 10 candles; but owing to the supply of ocote being very irregular, it not being possible to rely on the Indians who collected it, ordinary wood was oftentimes obliged to be substituted. This would only yield about 7500 or 8000 feet to the 2000 lbs., and of very feeble illuminating power. To meet this difficulty the upper retort was converted into a resin retort, the resin being supplied from the cistern above. The gas from the wood mixed with the resin gas gave an illuminating power equal to about 12 candles; but the gases thus generated required a very costly process of purification to free them from the excess of carbonic acid and pyroligneous acid derived from the wood gas. The difficulty of getting rid of the impurities just mentioned led the author to devise a means for using the gases derived from the decomposition of steam instead of the wood gas; but it being next to impossible to obtain suitable apparatus in a country like Mexico, a plan was adopted by which the wood retorts were made to serve the purpose for generating the water gas. In each of the two lower retorts a cast-iron tube about 5 inches diameter was placed. This was filled with scrap iron, and supplied with steam through a suitable pipe. Round this tube, and nearly filling the retort, was packed charcoal and lumps of native "Tysoutle," or pumice, a species of volcanic cinder found in almost every part of Mexico. The other arrangements were precisely the same as for the wood and resin gas, except that the gas was conveyed into an ordinary hydraulic main, and passed through a condensers, scrubber, and a set of lime purifiers in the ordinary way. The mode of working the apparatus was as follows:—The steam entered the iron tubes, or decomposing chambers, and a portion of it was converted into hydrogen by coming in contact with the heated scrapiron. The undecomposed vapour was converted into hydrogen, carbonic oxide, and carbonic acid, by the charcoal and pumice. These gases then entered the upper retort, where resin gas was generated, the mixed gases afterwards passing to the condensing and purifying apparatus; but the process had to be abandoned on account of the large quantity of carbonic acid present, and the great cost of its removal. The resin and wood process was ultimately adopted, and the city of Mexico has been supplied for the last five years with gas made from these materials. It will be in the recollection of most of the members of the association that the hydrocarbon gas, patented by Mr. White, was essentially a combination of water gas with resin gas; but the process, although tried under the most favourable circumstances at Rio Janeiro, never succeeded, although Boghead cannel was substituted for the resin. It appears that the only circumstances under which resin can be used with advantage for the generation of illuminating gas are where resin is cheap and wood for fuel abundant. In practice only about one-half of the weight of crude resin can be converted into gas. The residue is condensed in the shape of oil at a bright red heat. The quantity of gas for weight of resin actually converted will average about 850 lbs. per 104 lbs., or about 18,000 feet per ton English. The illuminating power of such gas will be about 14 standard candles. A very curious property the author observed in connexion with resin gas is, that when used by itself it travels with great facility, and does not lose its light-giving constituents; but if mixed with other gases, a deposit of a thick viscid substance takes place on the inner surface of the pipes and fittings, through which the mixed gases may have passed. To this cause may be attributed many of the complaints that were raised against White's hydrocarbon gas when it was first introduced.

The materials next in importance which have engaged the attention of experimenters in the manufacture of illuminating gas are the mineral oils, either in their natural state or as derived from treating shales or bituminous schists, and some varieties of asphaltes or mineral pitch. These substances, like resin, have been either used directly for the generation of gas, or have been used in combination with non-luminous gases. Within the last 10 or 15 years many patents have been taken out for processes or apparatus for the destructive distillation of these mineral oils, but up to the present time no process has been sufficiently successful as to secure for itself any general recognition. In Germany and the United States some of the attempts made to use crude petroleum have met with comparative success. The one which the author believes to be the best is the invention of a German chemist, Dr. Herch. The apparatus consists of a circular retort set in the usual manner. The retort is fitted with a mouthpiece

and lid at each end. The front mouthpiece is connected to a large cylindrical chamber or receiver by a taper pipe, which is substituted for the ordinary ascension-pipe. At the back of the retort is placed a small cylindrical vessel or chamber fitted with a cover and stuffing-box. In the interior of the chamber a weighted piston or plunger is placed, the rod of which passes through the stuffing-box. To the upper end of this rod a cord is fastened, which passes over a series of compound pulleys, and the end connected with a train of clockwork machinery. From the bottom of the box or chamber in which the piston is placed a small tube or pipe is connected with the lid at the back of the retort, and from thence a small taper tube projects into the interior of the retort. The process of manufacturing the gas is as follows:—The chamber or cylinder in which the plunger is placed is filled with the petroleum or mineral oil until the plunger has risen to the top. The cord is then coiled over the pulleys, and the end attached to the clockwork. As soon as the retort is sufficiently hot, the pendulum of the clock is set in motion, and the cord is gradually uncoiled. This liberates the plunger or piston, and thus the liquid in the cylinder is forced through the small connecting-pipe and taper tube into the retort, where it is distributed in a very thin sheet over the heated surface. A considerable quantity of the vapour is thus converted into gas, and is conveyed by the large taper pipe into the vertical receiver. Here the gas and vapours are separated by the cooling effect of the receiver, the permanent gas passing to a suitable gasholder, the condensed vapours, in the shape of tar or oil, fall to the bottom of the receiver, and are drawn off and returned to the first cylinder, when a fresh charge of oil is put in. The process is exceedingly ingenious, but the author is not able to say what the result of the experiment has been in a commercial point of view. In the United States many forms of apparatus have been tried, but most of them have failed on account of the great difficulty of getting rid of the rapid deposition of soot or solid carbon on the surfaces of the retorts, or the materials placed within the retorts to effect decomposition. It is found in practice that a comparatively thin layer of this finely divided carbon materially interferes with the process of decomposition, and the result is that when an apparatus has been at work for only a short time, it happens that the make of gas is reduced 50 per cent. If some arrangement could be invented by which this deposit could be prevented, there is no doubt that the mineral oils would be found most useful substitutes for cannel coal in the production of gas of high illuminating power.

Before entering upon a description of some of the processes in which mineral oils are used in combination with non-luminous gases, the author will briefly describe the system proposed for using wood and peat as gas-making materials. The use of wood for the manufacture of gas appears to have been suggested at about the same time as coal was being experimented upon. In the mechanical museum at Paris the author has seen the sketch and description of an apparatus invented in 1790 by a person named Lebon. It was evidently intended to compete with the invention of Mr. Murdoch, who was then engaged upon his experiments with coal gas at Redruth, in Cornwall. It does not, however, appear that Lebon's process was ever used beyond lighting his own house, as no mention is made of the introduction of gas lighting into France until 1815. After Lebon's invention, the first attempts to use wood for gas appear to have been made in Russia, but it was not until the experiments of Dr. Pettenkofer, of Munich, were made public in 1849, that any attention was given by gas engineers to the use of wood as a gas-making material. Since that time several cities and towns in Germany, Russia, and the north of Europe have been supplied with gas manufactured from wood.

In 1865 the author visited Germany for the purpose of making himself acquainted with the various processes then in operation for manufacturing gas from wood. He visited the works of Marburg, Darmstadt, Wurzburg, and Munich. The apparatus employed was the same as for coal gas manufacture, with the exception of one or two instances, where the ascension-pipes were cased and the hydraulic main was made double, leaving a space of two inches between the portion of the main into which the gas and products of distillation passed and the outer casing. The annular space between the two mains was filled with steam or heated air. It appeared that an essential condition for the success of the process was that the wood should be thoroughly dried or baked before being put into the gas-retorts, and that the temperature of the retorts should be maintained at a bright cherry-red heat. The illuminating power of the gas varied considerably, leading to the conclusion that in some instances a process of carburation was resorted to. An apparatus, designed for a town in the north of Russia, used the wood gas simply as a diluent, and made the illuminating power entirely dependent on its saturation by the vapours of naphtha. The apparatus used for carburetting has just been reproduced in this country by the patentee of the so-called "new gas."

The illuminating power of wood gas seems to depend very much on the quantity consumed. In practice it is found that a coal gas-burner consuming 5 feet per hour, and giving the light of 13 candles, will with the same consumption of wood gas only give the light of nine candles; but with a burner consuming 7½ feet per hour, the light from the wood gas will be 17·43 candles, as against 18·27 for coal gas. Mr. Riedinger, the engineer of the wood gas-works at Coburg, gives as the results of his experiments, that wood gas is 22 per cent. cheaper than coal gas, if the wood be taken before the essential oils have been extracted, and it is thoroughly dried before being subjected to distillation. The author found that by passing the gas through a second retort, heated to redness, the illuminating power of the gas was considerably improved. This is no doubt due to the decomposition of some of the oxides of carbon; but, unfortunately, the cost of purification was considerably increased owing to the larger quantity of carbonic acid that was present in the gas. The author, however, believes that if suitable precautions be taken in thoroughly desiccating the wood, there are many localities where wood gas might be used with advantage, especially if lime be cheap and abundant. What has been said in reference to wood will more or less apply to the use of peat as a gas-making material. At the present time a series of experiments are being made with peat which has been saturated with the refuse of shale oil distillation; but as the details of the experiments have not been made public, no opinion can be formed as to the merits of the scheme. Several other processes have been suggested for using animal and vegetable substances in the manufacture of illuminating gas; but as none of them have been carried beyond the stage of laboratory experiments, it is not considered necessary to enter into any details respecting them. The author, therefore, now proceeds to review the plans that have from time to time been brought forward to produce illuminating gas by the admixture of non-luminous but combustible gases with some form of volatile hydrocarbon.

The possibility of utilizing the effect produced by the action of heated metal on water in connexion with the manufacture of gas appears to have been first suggested by the late eminent gas engineer, Geo. Lowe, Esq. In a letter written by that gentleman to the "Philosophical Magazine" of Nov. 14, 1818, he describes his experiments at Derby. In speaking of the use of iron tubes filled with scrap iron, and heated to redness, he makes this remarkable statement: "But by passing the tar and water of crystallization through iron turnings, or over any oxidizable surfaces, the two are nearly all converted into gas, and come over with the hydrogen of the latter, which *has been liberated at the expense of the iron turnings*, and to me it is evident the great increase *arises infinitely more from the decomposition of the water than of the tar*." Twelve years after the experiments of Mr. Lowe we have the patent of Mr. Donovan, of Dublin, and a year or two afterwards the process of Mr. Saunders. These, in conjunction with the process described in the patent of Mollerat, may be said to have been the foundation of all the subsequent inventions employed for the decomposition of water by passing its vapours over heated surfaces. It is true that the precise form of apparatus has been modified in accordance with the views of each particular experimenter, but the essential principles involved in the process are throughout the same. To describe the mode of manipulation in general terms, it would be somewhat as follows:—Two or more tubes or retorts are set over an ordinary furnace by which they can be heated to the required temperature. These retorts are partially filled with scrap iron, or in the case of several retorts being set together, one retort may be filled with scrap metal, and the remainder may be partially filled with charcoal or coke. As soon as the retorts are heated to the temperature required (which should be a bright red by ordinary daylight) a stream of water or steam is injected into the retort containing the metal. Here the vapour is to some extent decomposed, the oxygen of the water being taken up by the heated metal, which thus becomes rapidly oxidized. The other constituent of the water, the hydrogen, is carried forward, along with any undecomposed vapour, and enters the retort or retorts containing the charcoal or coke. And here a considerable portion of the remaining vapour is decomposed, the resultant gases being hydrogen and the two oxides of carbon, as carbonic oxide and carbonic acid; the gases, therefore, escaping from the last retort consist of partially pure hydrogen, carbonic oxide, and carbonic acid, with some sulphuretted hydrogen and traces of bisulphide of carbon, the two latter due to the sulphur derived from the coke and impurities in the scrap iron. The gases after leaving the retort undergo refrigeration, thus separating them from any undecomposed vapour. They then pass through suitable purifiers to remove the excess of carbonic acid and the sulphur compounds. The gases so purified are rendered luminous by bringing them in contact with the vapours of some volatile hydrocarbon. In the earlier experiments highly rectified oil of turpentine was employed; but the discovery of benzole, by Professor Faraday, led to the more volatile compounds derived from coal tar naphtha being substituted for the essential oils in the carbonization of what was called the water gas.

Illuminating gas made by the process just described was tried in several towns in this country, Ireland, and on the Continent, but in all cases resulted in signal failure, as it was found impossible to compete with the simpler process of manufacturing gas from coal. About the year 1834 or 1835, considerable attention was drawn to a water gas process, patented in France by M. Selligue, in which a considerable modification of the decomposing process was adopted, inasmuch as the water vapour was conducted first into vessels or retorts containing charcoal, where it was converted into hydrogen and the oxides of carbon; in a third retort the gases so formed came in contact with the vapours of shale oil, and as this retort was nearly filled with iron chain or scrap, a considerable decomposing surface was exposed, and a large quantity of very superior gas said to have been obtained. But on subjecting the process to strict chemical investigation, it was found that some questionable proceedings had been had recourse to in carrying out the first experiments; when the chemist's report was presented the whole affair collapsed. From 1835 to 1849 a great number of schemes were brought forward, and some patented for improvements in the manufacture of water gas, but none appear to have succeeded. In 1850 a new process was brought forward by an American inventor named Paine. He proposed to generate pure hydrogen from water by the aid of a magneto-electric machine, and convert it into illuminating gas by passing it through camphine. The most marvellous results were claimed for this invention, and a monstre apparatus was prepared for the Great Exhibition of 1851, but the author believes that owing to the matter having been placed in the hands of Mr. Faraday, the fallacy of the so-called invention was exposed, and nothing more was heard of it. The well-known process of Mr. White for the production of hydrocarbon gas was at this period before the gas world, but as it resolved itself ultimately into a modified coal process, it will not be consistent with the object of the present paper, to make more than this passing allusion to it.

The enormous increase in the production of hydrocarbon oils, due to the discovery of the oil and petroleum springs on the continent of America, has given fresh impetus to the class of inventions which seek to substitute these oils for coal in the manufacture of gas. The direct destructive distillation of these oils has already been alluded to, but the utilization of the highly volatile vapours derived from the process of distilling these oils for general purposes has revived the idea of generating combustible gases by the decomposition of steam or water vapour. Of the several so-called inventions of the last four or five years, the only one which appears to present any new features is the one claimed by a Frenchman named Du Motay. It was originally intended as a process for the production of hydrogen to be used in connexion with the oxyhydrogen light, but in its modified form is being used in producing illuminating gas from hydrocarbon vapours.

The process may be described as follows:—Superheated steam is injected into a large retort or decomposing chamber filled with charcoal or coke, and heated to redness; here the vapour or steam is converted into hydrogen and carbonic oxide. From this mixture the carbonic oxide is removed by passing the gases through cylinders of hydrated or slaked lime heated to redness. The result of this treatment is the formation of a fresh equivalent of hydrogen, and the conversion of the carbonic oxide into carbonic acid by union with the oxygen of the decomposed water of hydration. The carbonic acid is removed by passing through more lime, and the hydrogen is passed on into another chamber, where it comes into intimate contact with a quantity of light petroleum spirit; here it loads itself with the vapour of the hydrocarbon, and continues on its course, passing next through a series of iron tubes heated to a low red heat, whereby a permanent gas is formed, precisely analogous in all its properties to the ordinary coal gas, but of considerably higher illuminating power. This invention has recently been in operation in the United States, and very favourable reports have been given as to the results, but no reference is made to the question of cost.

One of the old processes for manufacturing water gas has just been repatented in this country by a Mr. Ruck, who claims for it the title of the "New Gas," but in what the novelty consists it is difficult to discover. In this process it is proposed to use superheated steam, and the manipulation is somewhat as follows:—A bench of three or more retorts up to nine are set in, more or less, the ordinary manner. Alongside the top retort (which is considerably larger than the others), and within the oven are two cast-iron tubes or pipes, connected by an arch-bend, which passes over the top of the retort. If three retorts are set, this tube, or tubes, are made to communicate with the two lower retorts by means of cast-iron pipes and suitable connexions to a pipe which lies along the bottom of each retort inside, and extending to within a few inches of the back of the retort. From the mouthpieces of the bottom retorts two branch pipes lead to pipes which lie along the bottom of the top retort, also to within a few inches of the back. The two bottom retorts are partially filled with scrap iron, or pieces of chain, mixed with a portion of coke or charcoal. The top retort may also be partially filled with coke or charcoal. Communicating with the flange-pipes alongside the top retort a steam-pipe from any ordinary steam-boiler is fixed, capable of being closed at pleasure by means of a stop-cock or valve. The retorts being heated to the required temperature, steam is admitted to the flange-pipes, where it becomes superheated. In this condition it passes to the two lower retorts through the pipes laid along the bottoms, and, escaping at the back of the retort, it then comes in contact with the heated metal, or charcoal, or coke, and a portion of it becomes con-

verted into hydrogen and the two oxides of carbon. These gases, with the undecomposed vapour, then pass into the top retort through the branch pipes just described, and a further decomposition takes place. The resultant gases are then cooled and purified from sulphuretted hydrogen, and a small portion of the carbonic acid is taken out, and the mixed gases then are made to bubble through a quantity of light hydrocarbon spirit contained in a closed tank. This part of the apparatus is identical with the carburetting arrangement of the Russian wood gas previously described, but in order more readily to volatilize the heavier descriptions of petroleum spirit a current of warm air or steam is conveyed to the spirit-tank to maintain it at a suitable temperature. From the description just given it will be evident that the principle of the process is identical with all the previous inventions, so far as the means employed for the decomposition of the water vapour is concerned. It is true the patentee lays considerable stress on the use of superheated steam, but it is very questionable if there is any real importance to be attached to this part of the process. The intrinsic value of any of these inventions rests in the quantity of combustible gas that can be generated by the consumption of a given weight of fuel, and as the quantity of hydrogen to be thus obtained is the point of principal importance, it will be evident that the greater the weight of water decomposed by a given weight of fuel the more valuable the process becomes. For every 9 lbs. of water completely decomposed 180 cubic feet of hydrogen will be liberated. The proportions of carbonic oxide and carbonic acid will, however, vary according to the heat at which the process is carried on. The quantity of water gas produced by the consumption of a given weight of fuel varies considerably with the nature of the fuel employed. From a great number of experiments made by the late T. G. Barlow, Esq., the quantity of coke consumed per 1000 feet of water gas was found to average 60 lbs. In the author's experiments at Valparaiso, using the coke from a mixture of Australian and native coal, the average was found to be 73 lbs.; with charcoal, 101 lbs.; and with ordinary wood fuel, 127 lbs. per 1000 feet; and these are the results of experiments extending over several months. Mr. Barlow, in some instances, found that retorts making more than 600 feet per hour when first put into action gradually reduced in make to 352 feet per hour, and the average of a day's working was sometimes not more than 330 feet per working hour. Increased wear and tear occurs, due to the rapid oxidation of the interior of the retorts. This effect was fully shown in Mr. White's hydrocarbon process, and has been confirmed by all subsequent experimenters. The average duration of a water gas-retort is about 210 days, where a combination of scrap iron and coke or charcoal is used; but if scrap iron be used alone, from 170 to 180 days will be the maximum duration of such a retort.

Another important matter which requires consideration is the purification. It has already been shown that water gas is always contaminated with a very large quantity of carbonic acid, and more or less sulphuretted hydrogen, the latter increasing where coke is used instead of charcoal in the decomposing retorts. Supposing the process of purification be by lime, then the cost must be very great, because, from the greater affinity which caustic lime has for carbonic acid than for sulphur, it is obvious that the lime would absorb all the carbonic acid before it acted at all on the sulphur, and the removal of the sulphur compounds would depend on the amount of caustic lime left after all the carbonic acid had been taken up. If oxide of iron be used without lime, then the carbonic acid would remain, and of course materially diminish the illuminating power of the gas. It is suggested by the promoters of the "new gas" that the presence of carbonic acid might be commercially disregarded in estimating the value of the process, but in experimenting with gas made in the manner proposed, it is found there is a loss of nearly two-thirds in illuminating power when the carbonic acid remains in the gas. The same class of spirit burnt in combination with pure hydrogen gave 31$\frac{3}{10}$ candles, with unpurified water gas only 11$\frac{7}{10}$ candles. The deduction the author draws from these facts is that the cost of purification must always form an important element in estimating the value of any water gas process.

If the description here given of the so-called "new gas" be a fair one, it is evident that such a process can never come into competition with coal, except under very special conditions; in fact, the circumstances would be so exceptional that they can never occur in any country where coal is the staple source of fuel. In some countries, perhaps, where wood fuel is abundant, and petroleum or other mineral oils easy to obtain, it is possible such a process of obtaining illuminating gas might be successfully applied; but under the most favourable conditions such a process would have to contend against the disadvantages inherent to the use of a manufactured material instead of a raw one, and the risks of interruption in supply, or the certain loss that must always take place in storing such volatile materials as these light hydrocarbons are.

Proposals have recently been made to construct a special class of steam vessels to convey to this country the kind of spirit it is proposed to employ in some of these hydrocarbon processes. The model of a vessel is now being exhibited in London, fitted with tanks having a capacity for many thousand gallons of the spirit. By a very ingenious arrangement of floats and valves and spare tanks, the effect of expansion due to variation of temperature is provided for, and all risk of explosion avoided, although the tanks are hermetically sealed. A company has been formed in the United States to provide the necessary apparatus and store tanks for collecting this highly volatile spirit, and it is assumed that a quantity equal to about 200,000 barrels will be collected during the year. Supposing the whole of this material to be shipped to England, the quantity available for the manufacture of illuminating gas, after allowing for loss in transit and other contingencies, is estimated at about 7 millions of gallons—a quantity sufficient to manufacture about 400 million cubic feet of 24 to 25 candle gas.

The author now proceeds to a partial consideration of those processes in which air is to be made the vehicle for conveying the combustible material for the production of illuminating gas. This idea was suggested many years ago by the late Mr. Beale, of East Greenwich, and Mr. Wm. Maugham, the well-known lecturer on chemistry. The whole of the apparatus was contained in a portable lamp, but it was found so difficult to manage, and the smell from the naphtha vapour so disagreeable, that the invention never came into general use. Some years afterwards, the late Mr. Mansfield took out several patents for lamps in which a current of air was drawn through a reservoir filled with benzole, and thus became saturated with the hydrocarbon vapour; the air thus charged was then consumed like ordinary gas. During the exhibition of gas apparatus held in 1851, several contrivances were shown for carburetting air; one, the invention of an American engineer, was frequently explained at the lectures given at the Polytechnic Institution. In 1854 the author made a series of experiments with an apparatus patented by a Mr. Longbotham, of Leeds. This invention consisted of a pair of bellows set in motion by a small steam-engine. The current of air from the bellows was forced through or over pumice-stone saturated with oil of vitriol so as to render it thoroughly dry; it was then driven into a vessel containing highly rectified coal tar naphtha and bezole, in which gum resin had been dissolved; the air when saturated with the vapour then passed into a gasholder, from whence it was conveyed to burners in the ordinary manner. In the course of these experiments it was discovered that air gas requires burners with very large apertures to burn it properly, for any undue pressure causes the vapour to separate from the air. Another matter was the fallacy of the test of permanancy. By simply allowing the gas to remain at rest in a gasholder, the same gas tested from the gasholder showed scarcely any loss of illuminating power; but after passing through 120 feet of pipe, it was found to have lost nearly 20 per cent. Another circumstance to which attention was drawn is perhaps worth mentioning; it was that the deposition of hydrocarbon vapours increases with the quantity of gaseous material passing through a given length of pipe. This appears to arise from the want of homogeneousness in the structure of the vapours themselves. If air or combustible gas saturated with these dense vapours is made to pass through a long length of pipe, at first only a very slight deposit will be observed, but in the course of a short time a film of viscid matter will be found to have collected on the inner surfaces of the pipes; this film gradually increases, and after a time it will be found that a considerable quantity of liquid has accumulated from the vapours retarded by this viscid film. Gas engineers are all more or less acquainted with the effect produced by similar viscid deposits in the formation of naphthaline in coal-gas mains. In 1866 the author visited the United States, and while there had the opportunity of seeing a variety of processes for the carburetting of air; these were called gas machines. Most of these machines have been reproduced in this country under one title or another. Within the last six or eight months, nine patents or proposals for patents have been brought forward, based on the principle of saturating air with highly volatile vapours, but as they all involve the same general character, they all possess the same inherent defects—namely, want of permanency or danger of explosion. The former defect is due to the variable character of the oil or spirit used for carburetting the air. The higher the specific gravity of the spirit, the more unstable are the vapours. The author has found some samples that would give off vapour freely at a temperature of 60°, but would deposit 40 per cent. of their volume if the temperature were reduced to a little above 45°. As the specific gravity of the spirit becomes lower, of course the vapour is given off at a correspondingly lower temperature; in fact, in some samples of spirit with which recent experiments have been made, the vapour was found to be permanent considerably below the freezing point of water. The danger from explosion appears more to arise from the want of a proper quantity of vapour in the air than from the direct explosive property of the spirit itself. In the United States, where the most serious accidents have occurred, the causes of explosion have been shown to be the excess of air, either from the undue escape of spirit from the saturating vessel, or the effect of sudden and intense cold in checking the evaporation of the spirit, or, as has been the case in several instances, the adulteration of the spirit with a portion of heavy oil. But the risk of accident has become so great that a police ordinance has been promulgated at the instance of the American Insurance Societies prohibiting the use of *gasoline*, as this spirit is called, except in conformity with certain special regulations, such as the following:—"That no reservoir containing the spirit is to be allowed to be placed above the ground. That no such reservoir is to be placed within a distance less than 30 feet of any dwelling-house or enclosed building. That no reservoir is to be filled with gasoline after sunset or before sunrise. That no reservoir is to be made of any material but metal, and to be capable of being hermetically sealed."

One of the most recent modes of producing air gas is by making use of the weight of these vapours to induce saturation. A vessel containing some fibrous material is saturated with the hydrocarbon oil. To the lower end of this vessel a pipe is attached, terminating in an Argand burner with stop-cock. On the top of the vessel an aperture is made that can be closed by a metal cap. When the light is required the cap is removed, and the top of the burner is opened, a current of air is drawn through the saturated material contained in the body of the vessel by the descent of the heavy vapour, and on applying a light to the burner a very rich gas flame is produced. This arrangement is said to be the invention of Professor Greenhous, of the United States, who claims to have discovered a means of rendering these light oils non-explosive. Some startling experiments have been exhibited, but the author is not quite sure that the results were due to any special chemical preparation, or to the dexterity of the manipulator. If Professor Greenhous has discovered any method by which the volatility of these substances can be controlled, there can be no question but that he has conferred new value on these hitherto dangerous bodies.

In bringing this paper to a conclusion, the author would observe that he has purposely avoided any allusion to processes in which the distillation of coal enters, because he felt that the mere mention of the list of inventions embracing the partial use of coal in combination with some form of hydrocarbon would have extended the subject beyond all ordinary limits; he has, therefore, confined himself to the consideration of such materials and processes as could be employed in the production of illuminating gas without the use of coal under any form whatever.

And now, without for one moment disparaging the efforts of those who from time to time come before the public with suggestions for improving the manufacture of gas, either by simple destructive distillation or by a combination of chemical processes, he believes he is warranted in coming to the following conclusions:—

1. That no material or process invented or brought forward up to the present time can compete with coal in the manufacture of illuminating gas, except in countries or localities where coal cannot be obtained.

2. That the substances most suitable for the manufacture of gas are those from which it can be obtained by direct distillation, as in the case of oils, resins, and woody fibre.

3. That no process of gas manufacture can be considered successful where the resultant gases are not readily purified, or where, after ordinary purification, they contain an excess of substances injurious to animal life.

4. That no mere carburetting process can be commercially successful until some form of hydrocarbon is discovered that is perfectly homogeneous in its chemical structure, and that can be rendered sufficiently non-explosive as to admit of its being transported from place to place or stored with comparative safety.

Mr. R. P. SPICE said he would occupy as little time as possible in the few remarks he should have to make, and generally he might sum up that part of the paper which related to what was called "new gas," as in fact the whole paper might be described, as a list of failures in the direction of making gas companies independent to some extent of coal. Now, so far from viewing it as an objectionable matter or point to aim at, he held that it was desirable in the present state of affairs in the coal trade that gas managers *should* endeavour to seek some relief from other quarters, and so far as he was concerned this had been one of the motives by which he had been guided. He had felt that if water gas could be made at less cost, and of equal quality as far as light-giving properties as coal gas, a benefit must needs be conferred upon gas companies whether at home or abroad. When he first proceeded to inquire into the subject he had little idea that it could be of much value to gas companies in England, but he thought that if a permanent gas was procurable in this way it would be a great advantage to those engaged in foreign undertakings where coal was not easily procurable. But when he found that he could make 18-candle gas from water, with the aid of coke and petroleum spirit, at a cost of 1s. 8d. per 1000 cubic feet, it dawned upon him that while gas coals cost nearly 30s. per ton, and gas therefore of the same quality must cost 2s. 6d. per 1000, he might here find his way to the practical working of something that would be of value to gas companies at home. He had met with nothing in the whole course of his subsequent inquiries which had shaken his conviction in the correctness of that conclusion. He held in his hands reports of what was now being done with this gas on a practical scale at the present time in the city of Chichester, and he would read the reports of the superintendent there, dated the 23rd of May and the 7th of June.

The following are tests taken at the office of the City of Chichester Gas Company with

gas now being supplied to the city, being about two-thirds spirit gas and one-third coal gas:—

Burning Four Feet per Hour.

London Argand burner	15·50 candles.
No. 6 brass fishtail	11·25 ,,
Adamas No. 6	10·75 ,,
Leoni's patent British Standard, No. 6	11·50 ,,

Burning Five Feet per Hour.

Sugg-Letheby Argand burner	18·75 candles.
No. 6 brass fishtail	14·00 ,,
Adamas No. 6	12·50 ,,
Leoni's patent British Standard	14·75 ,,

May 23, 1873. ROBT. CHURCH, Jun.

Water "Gas," tested at Chichester Gas-Works, June 7, 1873.

Argand.	Fishtail.	Fishtail.
Sugg-Letheby.	No. 6. Bray's.	No. 6. Bray's.
5 Cubic Feet per Hour.	5 Cubic Feet per Hour.	4 Cubic Feet per Hour.
18 candles.	13·5 candles.	7·75 candles.

EDWARD THORMAN, Jun., Superintendent.

Now this gas was being supplied daily in varying proportions to the city of Chichester, not because the company could not supply it in its simple purity, but because they found it convenient to make some portion of coal gas so that they might have coke produced on the works for use in their water gas retorts. And he might here state that it had been his view all the way through that gas companies would find the "water gas" process useful as a supplementary process while coal was dear, and not as superseding their ordinary mode of manufacture. And his idea was this, that a coal gas company might in many cases find it convenient to make just so much coal gas as would suffice to obtain the requisite quantity of coke, and to use that gas in combination with water gas. At one time the water gas was supplied in Chichester entirely, but this difficulty was found, that with the common fishtail burners in use there, as in many other places, such good results could not be obtained as with the mixed gases. But there was no difficulty in finding suitable burners; they were to be picked up anywhere, and certainly as regarded Chichester there had been and was no failure in the "water gas" system. So far as Mr. Gore's allegations were concerned, the best and most conclusive way of dealing with them was to let Mr. Gore answer himself. He would read a letter addressed by Mr. Gore to him (Mr. Spice) and Mr. Joseph Quick, who asked his opinion on the subject. They attached some importance to his opinion, having been informed of his experience in the manufacture of water gas in the city of Mexico and in Valparaiso.

Gentlemen,—In reply to the questions you have submitted for my consideration, I beg to report as follows:—

In reference to the first query, as to whether I consider it commercially practicable to produce an illuminating "gas by generating hydrogen, or any combustible but non-luminous gas, and afterwards saturating such gases with the vapour of petroleum or other hydrocarbon oils or spirit."

To this question, I beg to say that such a process is practicable as a commercial undertaking, supposing that the following conditions are complied with:—First, that the gases generated are permanent and non-condensable; and, second, that the saturating or hydrocarbon vapour is of such a character as to be capable of remaining suspended in the gas or gases at all ordinary temperatures. The class of vapour required can be obtained from almost any description of hydrocarbon spirit, the specific gravity of which does not exceed 680°.

With regard to the experiments made by Messrs. Joseph Quick and Son and Mr. R. P. Spice, I believe them to be perfectly trustworthy so far as regards the illuminating power of the compound gas, and also as to its permanency when exposed to considerable variations of temperature and the effects of friction in long lengths of pipes.

In respect to your second question—"That of the possibility of an illuminating gas, generated in the manner proposed, being used as a substitute for ordinary coal gas"—I am of opinion that the compound gas could successfully compete with coal gas as a source of artificial light, in situations where gas coal is expensive and difficult to obtain; in such localities, gas manufactured in the way you propose, might be introduced with advantage, because non-luminous gas may be generated from a variety of materials, such as wood, peat or turf, and other vegetable matter, or by the decomposition of water by the action of charcoal, or anthracite coal. The gases obtained from any of these substances can be converted into an illuminating gas by being saturated with the vapours of any suitable hydrocarbon. The compound gas could be most successfully employed for artificial light in warm climates or in countries where the temperature is comparatively uniform, and where wood is generally abundant.

As regards the comparative value of "air gas" and the gas manufactured by the process now under consideration, I am of opinion that the advantages are infinitely in favour of the latter. The so-called air gas consists in nothing more than the use of a current of atmospheric air to convey the highly volatile vapour of hydrocarbon spirit to a gas or other suitable burner where it is to be consumed. The air does not assist in the combustion of the vapour at all; consequently, a considerable portion of the spirit is expended in generating sufficient heat to ignite the particles of carbon from which the light is to be evolved; whereas, in the gas made by your process, the heat necessary for perfect combustion is obtained from the gas itself, and the hydrocarbon vapour is consumed under circumstances the most favourable to furnish the maximum amount of light which it is capable of giving. The want of permanency in the so-called air gas is fatal to its use as an ordinary means of illumination. Experiments have shown that any considerable reduction in temperature is invariably attended by a corresponding loss in illuminating power. The union between the lighter permanent gases, such as hydrogen, marsh gas, and carbonic oxide and hydrocarbon vapours, is more intimate than between atmospheric air and such vapours; consequently, there is less liability for the compound gas to be affected by change of temperature or friction.

Air gas being nearly of the same specific gravity as the surrounding atmosphere, cannot be conveyed through pipes or tubes without the exercise of considerable propelling power; it is therefore next to impossible to employ air gas as an illuminating agent over extensive areas. The compound gas can, like coal gas, be conveyed to a considerable distance, the specific gravity of the two being nearly the same.

Many other reasons might be given in favour of the gas you propose to manufacture as compared with the so-called "air gas," but those adduced will, I think, prove amply sufficient to show the superiority of the one over the other, both as regards its physical constitution as well as its value as a commercial enterprise. HENRY GORE.

9, Islip Street, Kentish Town, Dec. 28, 1872.

But in the face of this Mr. Gore concluded his paper with a sentence like the following:—

"No material or process invented or brought forward up to the present time can compete with coal in the manufacture of illuminating gas except in countries or localities where coal cannot be obtained."

Surely he must mean his remarks as a joke. It was in effect to say that two horses were to run in a race, but one would have no chance except the other was kept at home. He (Mr. Spice) would only, in conclusion, refer to a report which had been received from Dr. Louttit upon the supposed poisonous character of the gas of the New Gas Company as compared with ordinary coal gas. The experiments were tried upon rabbits, which, at the present moment, were alive and well after partaking of a considerable portion of this gas in the state in which it was delivered to the public.

Experiment No. 1.—Bell jar filled with a mixture of coal gas and air—1-12th coal gas, 11-12ths air—rabbit put in; result as follows:—15 seconds, eyes twitching; 30 seconds, breathing hurriedly; 1 minute, breathing hurriedly, eyelids rapidly twitching; 1½ minute, dropping of ears, with slight convulsive movements; 2 minutes, continuation of the same; 2½ minutes, increased convulsive movements, moving about in jar; 2 minutes 45 seconds, sitting quietly in jar; 3 minutes, the same; 3½ minutes, the same; 4 minutes, breathing very hurriedly; 4½ minutes, moving in jar, pupils dilated; 5 minutes, suddenly became collapsed and comatose. The rabbit was then removed out of jar, and recovered as follows:—In 1 minute 10 seconds, gradually recovering, breathing quietly; 2 minutes, pupils beginning to dilate, breathing normal; 3½ minutes, moving about, but with a little difficulty; 5 minutes, recovered; running about looking but little worse for the inhalation of the gas. No sign of paralysis.

Experiment No. 2.—Bell jar containing a mixture of water gas and air—1-12th water gas, 11-12ths air—rabbit put in; results as follows:—30 seconds, no perceptible result; 1 minute, moving in jar; 2 minutes, lying quiet, no convulsions; 2½ minutes, becoming comatose, slightly convulsed; 3 minutes, lay down in jar, breathing hurriedly; 3½ minutes, quiet, partially comatose, but now breathing quite normal; 4 minutes, twitching of lips and tongue (not protruding); 4½ minutes, the same; 5 minutes, the same; 10 minutes, comatose. The rabbit was then removed from jar, and recovered as follows:—In 1 minute, pupils contracting, breathing becoming normal; 2 minutes, moving head about; 4 minutes sitting up, there has been *no* paralysis of hind extremities; 5 minutes, the rabbit had entirely recovered, and appeared in no way hurt from the inhalation of the gas.

Experiment No. 3.—Bell jar containing a mixture of coal gas and air—quarter coal gas, three-quarters air—rabbit put in; result as follows:—5 seconds, screaming; 1 minute 15 seconds, strong convulsions; 1 minute 25 seconds, collapsed to bottom of jar; 1 minute 30 seconds, comatose, with convulsions; 1 minute 45 minutes, completely comatose. The rabbit was then removed from jar, and recovered as follows:—In 45 seconds, breathing hurriedly, paralysis of hind extremities; 2 minutes, breathing becoming normal; 3 minutes 30 seconds, sitting up and recovering; 5 minutes, moving about; 8 minutes, quite recovered.

Experiment No. 4.—Bell jar containing a mixture of water gas and air—quarter water gas, three-quarters air—rabbit put in; result as follows:—28 seconds, slight convulsions; 33 seconds, convulsions; 45 seconds, the same; 1 minute, comatose; 1 minute 52 seconds, completely comatose. The rabbit was then removed from jar, and recovered as follows:—In 30 seconds, began to exhibit symptoms of returning animation; 45 seconds, sitting up on hind legs; in 3 minutes, running about, quite recovered.

Experiment No. 5.—Bell jar containing a mixture of coal gas and air—half coal gas, half air—rabbit put in; result as follows:—3 seconds, screaming; 12 seconds, pupils contracting, eyelids moving spasmodically; 15 seconds, ears dropping, gasping for breath; 30 seconds, convulsions; 34 seconds, fallen to bottom of the jar, all the extremities perfectly paralyzed, back doubled; 1 minute, screaming faintly; 1 minute 5 seconds, completely comatose. The rabbit was then taken out of jar, and recovered as follows:—In 6 seconds, convulsive twitching of all extremities; 12 seconds, the same; 20 seconds, perfectly comatose, breathing normal, slight convulsive movements, pupils dilating and contracting, extremities still partially paralyzed; it remained in that state until the expiration of five minutes, when it began gradually to recover, and in a quarter of an hour was sitting up, but did not shake off the effects for fully half an hour.

Experiment No. 6.—Bell jar containing a mixture of water gas and air—half water gas, half air—rabbit put in; result as follows:—30 seconds, convulsions; 45 seconds, fallen to bottom of jar; 50 seconds, lying quietly at bottom of jar and breathing hurriedly; 1 minute 10 seconds, perfectly comatose, paralysis of *hind* extremities only. The rabbit was then removed from jar, and recovered as follows:—In 30 seconds, breathing in short gasps, screamed faintly; 45 seconds, continued screaming slightly, pupils dilated; 1 minute, breathing hurriedly; 1 minute 30 seconds, eyelids rapidly twitching; 1 minute 45 seconds, ears twitching; 2 minutes 45 seconds, breathing quite normal, opening and closing eyelids, still partially paralyzed in hind extremities; 5 minutes, moving; 10 minutes, attempted to sit up, but failed; 18 minutes, sat up, animation returning; 20 minutes, running about; at the expiration of 30 minutes there was no apparent paralysis of hind extremities, and the rabbit appeared perfectly well and hearty.

The jar used in my experiments was a bell-shaped glass jar, about 2 feet high and 1 foot in diameter. The rabbits were healthy young ones about three months old. The experiments were performed in presence of Mr. Sharp, my assistant, and several superintendents of Mr. Ruck's works at Greenwich. I think that I have proved conclusively that carbonic oxide gas in presence of hydrogen is, at least, not more poisonous that carburetted hydrogen gas. These rabbits were the subjects of frequent experiments, were soon after, and now are gambolling about as healthy and strong as if they never were the innocent recipients of the debated poisonous properties of the two gases. This subject is a matter of extremely interesting scientific investigation, and can be performed by any one capable of conducting the experiments properly.

Greenwich, May 20, 1873. JAS. LOUTTIT, M.D., M.R.C.S., &c.

P.S.—Since writing the above, I am glad to see in the JOURNAL OF GAS LIGHTING of the 3rd of June inst., that, in reply to a very able paper read by T. Wills, Esq., F.C.S., before the Society of Arts, Mr. H. P. Stephenson said that "Messrs. Frankland and Wright made experiments some years ago in order to ascertain the effect of carbonic oxide upon animal life as compared with the effect of ordinary coal gas They experimented upon two rabbits of about the same age and weight, and the results of their experiments were that carbonic oxide is not more poisonous than ordinary coal gas." I am glad to be able to confirm the accuracy of the experiments made by the above-named distinguished gentlemen, and also to prove that carbonic oxide, either alone or mixed with air in varying proportions, is not more poisonous to animal life than ordinary coal gas in the same proportions. J. L.

June 6, 1873.

A considerable mistake had been made on this subject. He (Mr. Spice) had taken the opportunity to ask Dr. Odling, and afterwards Dr. Frankland, "Do you see any objection to the use of this gas as a means of lighting ordinary apartments?" Dr. Frankland's answer was, "None whatever," and Dr. Odling's, "Not the least."

The PRESIDENT said if it were convenient to Mr. Spice he was sure the meeting would be interested to have some details supplied as to the cost of this gas. Mr. Spice had spoken of the cost as 1s. 8d.; but what the meeting would like to know was, the quality of coal used in producing a given quantity of gas, and also the amount of fuel, and the quantity of hydrocarbon employed, the labour, and, in fact, a practical statement of the cost of producing the gas. He thought there was a general impression—and certainly he had been led to that impression himself from experiments he had made—that no process had yet been described by which hydrocarbons could be combined with hydrogen after both had been volatilized by destructive heat.

Mr. SPICE said he had none of the figures before him, but he thought he could furnish the information desired from memory. With regard to coal, they used no coal at all as coal; they used only coke, and water, and iron, and spirit. Those were the elements with which they had to deal. The water was converted into steam, and that steam was passed through a superheater, fitted in the same oven containing the retorts in which the gas was to be manufactured. It was then passed through a set of retorts, whether three, or five, or seven, from one to the other, so as to effect its perfect decomposition, but practically it was taken finally through a single retort. The operation up to this point was effected by the use of iron, steam, coke, and water. Each retort with which he had operated contained 1½ cwt. of coke and 1 cwt. of iron. One ton of coke put in and worked off, *plus* the steam, would produce 132,000 cubic feet of gas. To effect this he found it requisite to employ 2 tons of coke in the furnace, therefore there were 3 tons of coke employed to produce 132,000 cubic feet of gas. What the labour was, and what the wear and tear amounted to, he did not at the moment remember; but all things included came to about 7d. per 1000 cubic feet of gas produced, estimating the value of the coke at 20s. per ton. This was for the first portion of the process. Having passed the gas through a condenser and a washer, constructed after the fashion of Coffey's still, it was passed through a purifier containing oxide of iron, by which all the sulphurous products were taken out. It was then found that the combined gas consisted of hydrogen, carbonic oxide, and carbonic acid. The quantity of the latter was about 10 per cent., and the illuminating power of the gas with this per centage was from 17 to 18, and sometimes 19 candles. The cost was brought up to 1s. 8d. by taking the cost of the spirit at 8d. per gallon, which he had been assured by those interested in the undertaking was a price quoted as quite the outside cost, and 1½ gallon was required for each 1000 feet of gas. His experience in the matter led him to conclude that in this respect he had been rightly informed. He believed they would be able to obtain pure spirit at that price. With regard to the difference between 7d. and 1s. 8d., there was an odd penny somewhere for some little attention to the apparatus. The two divisions of the sum were 1s. 1d. and 7d. In conclusion, he wished it to be understood that he was not present in the interest of any set or clique, and that he knew of no interest in this matter opposed to the interest of the gas companies throughout the country. He would also add, that he had always considered the interests of gas consumers and proprietors as identical, and it must be so. The prosperity of the companies depended upon that of those whom they supplied, and this must extend throughout the whole process, and apply equally to both systems.

Mr. KELSALL (Ashton) asked what kind of spirit was employed in the operation, and where the New Gas Company succeeded in getting it at 8d. per gallon.

Mr. SPICE said it cost 13 cents f.o.b. at Philadelphia. He was not sure what the price at the well was, as this was not a matter which came under his care. The company depended upon Mr. Ruck, the oil refiner, as to the source of supply, and this had been the subject of inquiry by the board of directors. They had actually bought the oil, and had now a cargo on the way, at 13 cents, which meant 6½d. f.o.b., and when all expenses were paid on to their wharf on the Thames the cost would be 8¼d. or 8½d. per gallon. There was about 25 or 30 per cent., depending upon the character of the spirit, which was drawn off at a low heat, of the specific gravity of 650 to 680. This gas was an admirable carrier, but it would not carry more than 680. If tried beyond that it was like handicapping a horse till he was broken down. He had tried the experiment with oil of 690°, and had had to pump the spirit out of his gasholder syphon. Anything below 680 would travel any reasonable distance. He had gas still in store which was made in the month of October last at Mr. Ruck's factory, at Greenwich, which had been shut up in a 5-foot experimental gasholder during last winter, and was good now. He knew that the union between the hydrogen and the hydrocarbon was not chemical but mechanical; still it was an exceedingly good union, and lasted long enough for all practical purposes, and he ventured to say that the gas produced by this process was as permanent as coal gas. He had tried it after it had been shut up for 24 and 48 hours and even a week, and found it had a much better illuminating power than 20-candle coal gas would have had when so tested. The specific gravity of the gas varied from 518 to 525. He had found it a little less than that.

The PRESIDENT said he did not understand what quantity of hydrocarbon was required for the 132,000 cubic feet of gas spoken of.

Mr. SPICE said he found that 1½ gallon of spirit, such as he had described, would saturate, in round numbers, 1000 cubic feet of gas—964 cubic feet was the exact quantity on two occasions. He had made the experiment with "air gas," and found it required 2½ gallons. He had passed the water-gas through a freezing mixture, putting it in at 60°, and taking it out at 38°, and found that it made no difference in it, whereas the so-called "air gas," put in at 60° and taken out at 40°, was found to have lost 33 per cent. of its light-giving power.

The PRESIDENT said there was one other question. It seemed from Mr. Spice's statments that about 200 gallons of oil were required for the 132,000 cubic feet of gas. What remained? what residuum was there?

Mr. SPICE said he had never worked off the entire quantity; one reason for not doing so was that they found with the spirit, which cost them 8d. as they received it, when they had rectified about half, the residue was worth more than it was before.

The PRESIDENT: Better have it all residue.

Mr. SPICE said he did not mean that what was bought for 1s. was sold for 1s. 6d., but that what they took out left the residuum 700° or 720°, and in the market that heavy spirit had a value which the lighter spirit had not. The light spirit was only valuable for this gas-making purpose; but the heavy spirit had a value beyond the original rate of cost. They were now in treaty for the sale of the residuum at 1s. 0½d. per gallon.

The PRESIDENT: And you have taken that into consideration in making your estimate up to 1s. 8d.?

Mr. SPICE: That is part of the consideration.

Mr. JABEZ CHURCH thought the members of the association might congratulate themselves on having had the paper read, for he thought of all places in which the "new gas" was introduced, this surely ought to be the principal. He recollected that at the last meeting they had the opportunity of discussing the "patent gas," and they had a very eloquent description given by Mr. Mellor, who treated the matter in the most fair and gentlemanly manner. The opinions expressed on that occasion by the members of the association he (Mr. Church) thought had been fully borne out by the results of the last year's working. He was bound to confess that he himself was not converted to the "new gas," but he thought they ought to hail all inventions with great satisfaction, and give to the inventors every encouragement to develop their processes. There certainly never was a time when inventions to produce illuminating gas without the use of coal were more needed than at the present, and as gas companies were situated in England, he thought such inventions would be more useful here than in any other country. But the merits of this "new gas," in common with all other inventions, must be determined on commercial principles, and it appeared to him difficult if not impossible to arrive at anything like an estimate, except such as must be entirely conjectural, as to the cost of this gas. For this reason, in the first place, the petroleum spirit was of little value at the present time, but if it came to be generally used for gas-making it was only fair to conclude that the price would rise immensely; secondly, at the present time coke in gas-works was a common residuum, and its value was not very great, but if no coke was produced in the manufacture of gas that article would become very dear; and, seeing that large quantities were required in the production of the "new gas," it was difficult to imagine the price to which it would rise. Then, again, there was the heating material for the furnaces; he believed Mr. Spice had not mentioned whether coal or coke was used for the purpose.

The PRESIDENT: Coke.

Mr. CHURCH: Seeing that no coke would be obtained in the manufacture of gas by this process, here would be an additional source of expense. In forming a judgment upon the probable commercial success of the invention these elements were of considerable importance. Taking also what Mr. Gore said to be true, that the wear and tear of the iron retorts was excessive, that, looking at the high price of iron, was no unimportant matter. And after all came an element which must not be lost sight of, though, perhaps, it was more a matter for chemists to determine; but, as far as gasmen had been educated in chemistry, they had always looked upon carbonic oxide and carbonic acid as very detrimental to the light-giving properties of gas, and very injurious to the atmosphere in which such gas was burned. It was without any disparagement to Mr. Spice that he ventured to throw out these remarks; indeed, the name of Mr. Spice being associated with the process was to him a guarantee to some extent of the *bona fides* of the invention.

Mr. HARTLEY said his name having been mentioned by Mr. Spice, he would ask leave to make a few observations upon the subject before the meeting. His connexion with the scheme was this. Mr. Spice, after having engaged his services in relation to an air gas scheme (which experiments proved to be of an unsatisfactory character), asked his co-operation in making experiments on this new-old invention. He (Mr. Hartley) had had some experience in reference to water gas when Mr. Wright was associated with other gentlemen years ago in investigating the scheme of Mr. Gillard, therefore the process was not unfamiliar to him; and he might say that he started on his recent investigation with the full conviction that the whole thing must be a radical failure. In the first place he had believed, as an indispensable necessity, that every particle of carbonic acid must be removed from the gas, and therefore that the process would be very expensive in respect to the cost of purification. But, to his astonishment, when he came to make experiments, he found that the removal of carbonic acid by actual purification was not necessary for the production of illuminating gas. Furthermore, he was completely surprised to find that the gas made by this process, after if had passed through a long coil of mains laid in an open field, possessed practically, at the end of that main, an illuminating power equal to that which it possessed previous to passing through the mains. In the face of such evidence as this, and after having seen the manufacture of the gas continued for some time, he felt himself bound at last to give the testimony which was published in the prospectus of the company. The practical working of the process had of course yet to be determined. With reference to the introduction of the scheme at Chichester, he had not been associated with Mr. Spice in that city except to the extent of supplying certain apparatus, but he had been there, and was delighted one night to see the whole of the streets lighted with the new company's gas pure and simple. Since then Mr. Spice had told the meeting that he had found it desirable, for the sake of coke production, to supply the town with a mixture of this gas and coal gas. He (Mr. Hartley) could only say that he wished the scheme success in its practical and commercial issue, because he felt assured that if it were so it would materially serve the interests of the gas world. He had heard very little of Mr. Gore's paper, and could do no more than express his surprise at the apparent antagonism evinced to the new company's process. It should be distinctly known and understood that when the scheme was under experimental trial he had urged Mr. Spice to seek the advice and assistance of Mr. Gore, believing, as he (Mr. Hartley) then did, that Mr. Gore's experience would be of great value. Mr. Gore received from Mr. Spice and from himself every possible information—every known detail—in respect to the working and the results attained, and afterwards Mr. Gore voluntarily wrote the document which was published in the prospectus of the new company. Under these circumstances, he (Mr. Hartley) could not but be astonished when he afterwards found Mr. Gore making an effort to recant. Whatever reasons Mr. Gore had for altering his opinion it was impossible for him (Mr. Hartley) to surmise; but it was a singular and startling fact, that having expressed an opinion favourable to the scheme, Mr. Gore had afterwards tried to discredit it, when it was about to be worked commercially, and when, moreover, a disclaimer, however sound or otherwise, was too late to serve any useful purpose.

Mr. G. W. STEVENSON said he thought it was only fair to an absent man that he should call attention to the fact that so much of Mr. Gore's report as had been read went only to a comparison between "new gas" and "air gas." He did not at all understand that Mr. Gore withdrew his allegiance, so far as it had ever been exhibited, from the "new gas" scheme, although when he said that new gas was better than air gas it sounded somewhat as though he damned it with faint praise. He (Mr. Stevenson) thought Mr. Spice must have been a little misunderstood if it was assumed that he stated the cost of 132,000 cubic feet of new gas to be £16. There must be some discrepancy somewhere, because that would make the prime cost nearly 2s. 6d. per 1000. With reference to the invention altogether, he had only to remark that it seemed to him to be premature at present to express any opinion upon the value of the gas produced. The whole affair was in very good hands; Mr. Spice had experience and talent, and was a man of perfect integrity, and, therefore, they might rely on it they would ultimately know the true value of the invention, both in its engineering and its commercial aspect. For his own part he (Mr. Stevenson) left it in Mr. Spice's hands with the most entire confidence. Probably this time next year he would be able to tell them something more about it.

Mr. G. ANDERSON asked whether the 1s. 8d. given as the cost per 1000 cubic feet included wear and tear and the ordinary expenses into the gasholder.

Mr. SPICE said the 132,000 cubic feet did not apply to the £16. The 132,000 cubic feet of heating gas became 165,000 cubic feet of lighting gas by being passed through the petroleum spirit, and the cost was a fraction below 1s. 8d. per 1000, all charges included, into the gasholder, the increase in volume being 25 per cent.

Mr. R. H. JONES (Dover) read the following paper:—

ON GASHOLDER CAPACITY COMPARED WITH CONSUMPTION.

What should be the gasholder storeage in a well-managed gas-work?

I think this question is one which may be discussed by gas managers, and with very much advantage to those who are short of gasholder storeage, and who find it difficult to persuade their directors to provide for the increasing wants of their business.

This question also commends itself to the attention of such of the members of this association as are desirous of promoting the movement for the reduction of Sunday labour in gas-works, for with an insufficient storeage for gas it is impossible to reduce the labour on Sundays.

As I am a man of figures, I thought the collation of statistics from different gas-works in the kingdom would give one some idea of what is generally considered as a sufficient per centage of gasholder storeage as compared with the maximum daily consumption, and I accordingly sent out some 350 circulars to managers of gas-works, and have received answers to about one-half of my circulars.

These replies I have grouped under five different heads—viz.,

Group A.—Returns from small gas-works where the maximum daily consumption is below 100,000 cubic feet.

Group B.—Where the maximum daily consumption is between 100,000 and 250,000.

Group C.—Where the maximum daily consumption is between 250,000 and 500,000.

Group D.—Where the maximum daily consumption is between 500,000 and 1 million.

Group E.—Where the maximum daily consumption exceeds 1 million.

It will be seen from these returns that the gasholder capacity in one case is as low as 32 per cent., and in another it is as high as 200 per cent.; but on striking an average,

Group A.,	with 53 gas-works, gives a per centage of gasholder room, as compared with the maximum daily consumption, of	91·8	per cent.
Group B.—	42 gas-works, average	105	,,
Group C.—	26 ,, ,,	89·8	,,
Group D.—	15 ,, ,,	87·2	,,
Group E.—	17 ,, ,,	88·3	,,
	General average of the 153 gas-works	89¼	,,

It will be seen from these returns that in many cases additional gasholder storeage is much needed. On referring to the returns, I find many observations are added, thus:

The manager of a gas-work, with only 44 per cent. of gasholder storeage, writes: "Our vend is very much restricted by want of gasholder room; the difficulty of maintaining the supply during a winter's evening is the occasion of great and unceasing anxiety, and our stocks within the season referred to, usually range from 5 to 20 minutes consumption."

Another manager, with 46 per cent. of gasholder, writes: "Ours is a very rare case; we have to keep extra retorts alight to meet the supply."

The manager of a gas-work, with 65 per cent. of gasholders, writes: "We want more gasholder capacity badly, but wish to avoid putting up a new holder, and so increasing our capital while coal is so dear."

Another manager, with 63 per cent. of gasholder, writes: "You will see our gasholder capacity is miserably deficient. We are just going in for a large extension."

Several of those gas-works, where the storeage is less than 70 per cent., are about enlarging their gasholder capacity, and nearly all complain of insufficient storeage.

One gentleman, with 86 per cent., complains of being "short of gasholder capacity."

Another gentleman, a valued member of this association, and one of its vice-presidents, writes: "That his gasholder storeage has been recently in-

crossed to 98 per cent. of the maximum daily make," and adds, "this is not at all too much."

Opinions differ. I think myself that 98 per cent. is "not at all too much." The statistics I have collated show an average of 89¾ per cent.; but I have seen the written opinion of another eminent member of the gas profession, advising a board of directors that, with gasholders holding two-thirds (66 per cent.) of the maximum daily consumption, no extra retorts are required, and that consequently 66 per cent. of storeage is sufficient.

The object of my asking to be allowed to lay this paper before the members of the association of gas managers is to solicit their opinions as to what gasholder storeage should be provided to carry on the manufacture and supply of gas with safety and economy, and what additional storeage is needed to meet the movement for the diminution of Sunday labour.

Of course, in some localities, there is a large consumption of gas during daylight, and in the northern parts of the kingdom there is not so much daylight in winter time as in the south. These specialities require to be noticed in the discussion which may ensue on reading this paper.

GROUP A.

Fifty-Three Gas-Works—Maximum Daily Consumption below 100,000 *Cubic Feet.*

Maximum Consumption.	Gasholder Capacity.	Per Centage.
80,000	30,000	37
64,000	28,000	43
78,000	36,000	46
27,000	14,000	52
57,000	32,000	56
70,000	40,000	57
55,000	32,000	58
36,000	21,000	58
60,000	35,000	58
61,000	40,000	65
60,000	40,000	66
48,000	32,000	66
26,000	18,000	69
90,000	63,000	70
27,000	19,000	71
38,000	28,000	73
90,000	70,000	77
14,000	11,000	78
45,000	36,000	80
50,000	40,000	80
40,000	34,000	85
70,000	60,000	86
75,000	65,000	86
75,000	66,000	88
95,000	85,000	89
86,000	77,000	89
80,000	73,000	91
71,000	68,000	95
27,000	26,000	96
76,000	75,000	98
76,000	75,000	98
46,000	46,000	100
11,000	11,000	100
20,000	20,000	100
54,000	54,000	100
56,000	56,000	100
45,000	46,000	102
87,000	90,000	103
28,000	29,000	103
90,000	95,000	105
60,000	65,000	108
55,000	62,000	112
14,000	16,000	114
50,000	62,000	124
80,000	100,000	125
11,000	14,000	127
53,000	68,000	127
60,000	80,000	133
35,000	50,000	143
50,000	76,000	152
9,000	14,000	155
80,000	130,000	162
72,000	122,000	169
2,913,000	)2,675,000	(91·8 per cent. of gasholder storeage compared with maximum daily consumption.

GROUP B.

Forty-Two Gas-Works—Maximum Daily Consumption 100,000, *and under* 250,000 *Cubic Feet.*

Maximum Consumption.	Gasholder Capacity.	Per Centage.
102,000	54,000	52
175,000	100,000	57
168,000	98,000	58
234,000	140,000	60
100,000	60,000	60
185,000	116,000	62
174,000	110,000	63
150,000	100,000	66
120,000	90,000	75
136,000	98,000	75
248,000	200,000	80
148,000	120,000	81
110,000	90,000	81
120,000	100,000	83
110,000	92,000	83
130,000	110,000	84
155,000	134,000	86
160,000	140,000	87
200,000	190,000	95
105,000	110,000	96
168,000	156,000	98
230,000	225,000	98
190,000	190,000	100
170,000	192,000	113
149,000	178,000	120
207,000	250,000	120
146,000	180,000	123
180,000	240,000	125
136,000	170,000	125
230,000	290,000	126
195,000	250,000	128
115,000	154,000	134
5,140,000	4,727,000	

Maximum Consumption.	Gasholder Capacity.	Per Centage.
5,140,000	4,727,000	
110,000	150,000	135
147,000	200,000	136
130,000	178,000	137
180,000	260,000	144
100,000	146,000	146
120,000	180,000	150
160,000	246,000	153
210,000	346,000	165
100,000	180,000	180
110,000	220,000	200
6,507,000	)6,833,000	(105 per cent. of gasholder storeage compared with maximum daily consumption.

GROUP C.

Twenty-Six Gas-Works—Maximum Daily Consumption, 250,000 *to* 500,000 *Cub. Ft.*

Maximum Consumption.	Gasholder Capacity.	Per Centage.
410,000	130,000	32
400,000	210,000	52
300,000	163,000	54
380,000	212,000	55
260,000	150,000	57
290,000	190,000	65
300,000	210,000	70
260,000	220,000	71
454,000	330,000	72
290,000	220,000	76
250,000	200,000	80
400,000	320,000	80
400,000	324,000	81
480,000	390,000	81
452,000	400,000	88
330,000	295,000	89
363,000	335,000	92
270,000	250,000	92
448,000	461,000	103
280,000	295,000	105
270,000	290,000	107
450,000	520,000	115
330,000	400,000	121
496,000	600,000	121
480,000	700,000	146
440,000	700,000	159
9,483,000	)8,515,000	(89·8 per cent. of gasholder storeage compared with maximum daily consumption.

GROUP D.

Fifteen Gas-Works—Maximum Daily Consumption, 500,000 *and under* 1,000,000 *Cubic Feet.*

Maximum Consumption.	Gasholder Capacity.	Per Centage.
701,000	325,000	46
580,000	300,000	52
580,000	345,000	60
520,000	312,000	60
500,000	305,000	61
575,000	400,000	69
500,000	400,000	80
500,000	400,000	80
755,000	650,000	86
860,000	750,000	87
512,000	485,000	94
720,000	700,000	97
850,000	1,040,000	122
800,000	1,000,000	125
720,000	1,020,000	141
9,673,000	)8,432,000	(87·2 per cent. of gasholder storeage compared with maximum daily consumption.

GROUP E.

Seventeen Gas-Works—Maximum Daily Consumption, 1,000,000 *Cubic Feet and upwards.*

Maximum Consumption.	Gasholder Capacity.	Per Centage.
1,263,000	750,000	60
1,170,000	722,000	61
1,200,000	820,000	68
6,187,000	4,274,000	69
2,200,000	1,600,000	72
1,200,000	900,000	75
16,000,000	13,000,000	81
2,750,000	2,300,000	83
1,400,000	1,171,000	83
2,370,000	2,250,000	95
3,666,000	3,630,000	98
5,300,000	5,300,000	100
2,004,000	2,140,000	106
3,500,000	3,800,000	108
1,250,000	1,500,000	116
1,500,000	1,800,000	120
1,721,000	2,329,000	135
54,678,000	)48,286,000	(88·3 per cent. of gasholder storeage compared with maximum daily consumption.

Averages.

	Maximum Consumption.	Gasholder Capacity.
Group A	2,913,000	2,675,000
„ B	6,507,000	6,833,000
„ C	9,483,000	8,515,000
„ D	9,673,000	8,432,000
„ E	54,678,000	48,286,000
Total	83,254,000	) 74,741,000 (89·77 per cent. of gasholder storeage compared with maximum daily consumption.

Mr. CRAVEN (Batley) thought the gasholder capacity should be equal to one maximum day's consumption, as a rule.

Mr. HUNTER (Rochdale) said there was a fallacy in the arguments used by

gas managers who wished to shirk the question of abolishing Sunday labour in gas-works. He *understood* Mr. Jones to say that in many gas-works Sunday labour could not be avoided on account of the deficiency in storeage capacity, and numbers more argued in the same way. This must be fallacious, because it followed that if the storeage were only 50,000, and the consumption 100,000 six days in the week, it was the latter that ruled the number of retorts required to be in use; and it followed that if the consumption six days in the week was 100,000 each day, on the Sunday it would be so much less. At any rate that was the rule; consequently, instead of short storeage being an excuse for not avoiding Sunday labour, it was the very thing that compelled a manager to reduce it. And it sounded reasonable when he said that by keeping on the maximum number of retorts compared to the consumption, or the slightest excess, and by working to six on Sunday morning and from six on Sunday night, a manager, under the circumstances described, by Monday night would find as much gas made as he could possibly store. No doubt, on the other hand, a gas manager with an excess of storeage could work with a reduced number of retorts, and by working on the Sunday could make up the loss of the week. But such a course would be wrong, as it would certainly be doing on the Sunday what could and ought to be done on the week day. However, he only named this to show the fallacy of the argument when a manager stated that he could not avoid Sunday labour on account of deficiency in storeage. In regard to storeage compared to consumption, last winter the maximum consumption in Rochdale was about 1½ million cubic feet in the 24 hours, and the storeage 600,000 only. He did not envy any one working under such difficulties. Past experience led him to the conclusion that under ordinary circumstances the minimum storeage capacity ought to be equal to 75 per cent. of the maximum consumption in the 24 hours. Under any circumstances provision ought to be made in the retort-house, purifiers, gasholders, and throughout the works, so that all operations on a gas-work could be suspended for at least 12 hours on the Sunday. It could be done; and having settled the possibility, whether it was more expensive or cheaper, it ought to be done. Physically, intellectually, and morally the men required it, and the laws of God demanded it.

Mr. WOOD (Bury) said the question of gasholder capacity must be determined a great deal by the varying circumstances of the consumption in each locality. A town where private residences predominated could not be compared with a town full of manufactories. No arbitrary rate of per centage could be laid down, but the relative consumption of each town or district must be taken into consideration. In his own town the increased consumption by the mills from five to six o'clock in the evening was double what it was from six to seven o'clock.

A vote of thanks having been given to Mr. Jones, the proceedings in relation to the reading of papers were closed.

WEST OF SCOTLAND ASSOCIATION OF GAS MANAGERS.

The First Annual General Meeting of this Association was held in the Newton Town-Hall, Ayr, on Thursday, the 26th of June—Mr. WILLIAM KEY, President, in the chair.

The SECRETARY (Mr. Black) read the minutes of last quarterly meeting, and subsequent meetings of committee, all of which were unanimously approved of.

The PRESIDENT read the names of gas managers who had applied to be admitted as ordinary members since last quarterly meeting, as follows:—

Alexander M'Auslan . . .	Rutherglen.
Thomas Willet	Cambuslang.
Daniel Keith	Barrhead.
William Tait	Laurencekirk.
Thomas Blyth	Midcalder.
Henry Rutherford	Aberlady.
C. E. Porrie	Thurso.
James Menzies	Lerwick.
Laurence Hislop	Ayr.
James Cruickshanks . . .	Grantoun.
John Gibson	Kilwinning.
William Fairweather . . .	Duncon.
B. Howat	Sanquhar.
Hugh Blair	Girvan.
George Nevin	Airdrie.
Gavin Lambil	Froon.
Hugh Nicol	Ardrossan.
A. Walker	Irvine.

Mr. D. JEFFREY (Kirkintilloch) proposed, and Mr. A. MALAM (Dumfries) seconded, that these gentlemen be admitted, which was unanimously agreed to.

The following gentlemen were also unanimously elected as extraordinary members.

James Ross	Falkirk.
James Wood	Paisley.
F. C. Morrison	Ayr.
D. M. Nelson.	Glasgow.
Robert Brown, jun.. . . .	Lanemark.

The PRESIDENT stated that it was the prerogative of the committee to propose gentlemen connected with gas engineering as honorary members of the society, and the committee had now the pleasure of proposing two gentlemen well known to almost every member present—viz., Samuel Stewart, Esq., gas engineer, Greenock, and W. Walker, Esq., Ayr (late of Kilmarnock).

These gentlemen were unanimously elected.

Mr. STEWART, in returning thanks, said he felt the society was one which deserved every encouragement, and from which they would all derive great advantage. He was sure all gas managers in Scotland would give it countenance, for they all had the same object before them, that of making gas as good and as cheap as possible. He would be happy to do everything he could to further the interests of the association.

Mr. WALKER assured the society that he considered his election by them a great honour, and would do all he could to further the objects of the association. Although now out of the business, he should always take an interest in gas managers and gas-making.

The PRESIDENT said that the association was formed in October last, and that this was the second general meeting, the last meeting at Kirkintilloch being the first quarterly meeting. It might be necessary to make an explanation of how this meeting had been called by circular as the first annual general meeting, seeing the society had yet been only eight months in existence. By the constitution of the society the Midsummer meeting was deemed the annual general meeting, and at such meetings the office-bearers had to be elected for the ensuing year. As this was the first Midsummer meeting, it consequently became necessary to elect office-bearers, and seeing the association was of recent formation, it was a question whether the changing of office-bearers, or re-electing those formerly in office, would most conduce to the well-being of the society. The office-bearers had now virtually resigned.

Mr. JAS. RENFREW proposed that all the office-bearers should be continued in office for next year as they were.

Mr. JAS. GOUDIE (Ayr) seconded the motion, which was adopted.

Mr. KEY, for himself and in the name of all the office-bearers, thanked the society for their re-election, and said they would endeavour to pull together as hitherto as a committee. He could say that every member of the committee had regularly attended committee meetings and done all the work imposed on them. They would also work hand in hand with private members who had any suggestions to make, and would do their best, in the greatly increasing and encouraging position of the society, to conduct the business for the next 12 months.

Mr. HALL remarked, with regard to office-bearers, that perhaps some might think it was a prejudice on the part of the original members which induced them to re-elect the president, but he assured the new members that if they knew the amount of labour and time which Mr. Key had given to the association both in behalf of the managers fund and the drawing up of rules, beside the fact that he lived in such a convenient place, they would see grounds for satisfaction. When, too, the books were handed down to the members of the association in time to come, every one would be gratified to see the way in which Mr. Key had started the society, and approve of their choice of a president.

The PRESIDENT proposed that the office of secretary, which involved considerable labour, and the society's funds being good, such office should have the annual fee of £2 attached to it. This being agreed to, he then stated another auditor was required to be elected at this meeting to comply with their constitution, and to assist Mr. Robertson, of Campbeltown, and such auditor would, as the last elected, be the only one eligible for re-election next year.

On the motion of Mr. RENFREW, seconded by Mr. BLAIR, it was agreed that Mr. Jas. Goudie (Ayr) be appointed auditor, and that the auditors receive each 10s. per annum.

In reply to Mr. Stewart, the PRESIDENT said that the roll now showed upwards of 60 members of the association, and he congratulated them on its position seven or eight months after its formation. He also adverted to the prosperity of the funds, hoping the members would do what they could to add to them, as great strength lay in having money to give and parties to receive it; and this, along with the advantage of members, however distant, receiving the JOURNAL OF GAS LIGHTING fortnightly free, should be great helps to their recommendations.

A list of new members to receive the JOURNAL OF GAS LIGHTING was then made up, and the donations received by several members present to the managers fund during the past quarter declared to amount to £4 3s.

A cordial vote of thanks to the donors was then recorded.

Invitations from Mr. Hislop and Mr. Goudie, Ayr and Newton Ayr Gas-Works, to members and friends to visit their works, was then laid on the table.

Mr. BLAIR proposed that the next quarterly meeting of the society be held in Glasgow, in September, on a day to be fixed on by the committee. This proposal was seconded by Mr. BLACK, and unanimously agreed to.

Mr. A. MALAM (Dumfries) read the following paper on

A NEW METHOD OF UTILIZING HYDROGEN GAS IN THE IGNITION OF ILLUMINATING GAS ON HIGH BUILDINGS AND OTHER PLACES NOT EASILY ACCESSIBLE.

Hydrogen gas, which is 16 times lighter than atmospheric air, is the lightest of all gases known. It can be generated, as you are aware, in various ways. In its natural condition it enters largely into the composition of water, in proportions of 1 of oxygen to 2 of hydrogen.

It is likewise a constituent of coal gas, which contains more or less of it according to its specific gravity.

Before it can be made use of as an illuminating agent, it must be charged with hydrocarbon. This is easily accomplished by carburetting, as I now propose showing you. I take this chamber, which is filled with a sponge charged with benzine, or any other volatile hydrocarbons, and through this the hydrogen is passed, receiving in its passage sufficient carbon, to form a gas of excellent illuminating power. (Gas lighted at a jet.)

Coming to the more immediate subject of this short communication, I have to bring under your notice a method whereby hydrogen gas, stored up in the usual way, can be made practically useful in igniting coal gas on high buildings.

This lamp-column, a modification of which could be placed in immediate connexion with a line or circle of gas-jets to be lighted, is fitted up as you will perceive with two tubes for the conveyance of the hydrogen and coal gases.

Immediately opposite the hydrogen jet is placed a piece of platinum, with which no sooner does the hydrogen gas come into contact, than it instantly ignites. The coal gas burner is now turned on; and the result is instant ignition, which, running from burner to burner properly arranged, any number can be lighted up.

In bringing this small matter under your notice, I have explained the application of a principle which, so far as the lighting of buildings is concerned, I believe to be entirely new.

Mr. STEWART asked what the expense of preparing hydrogen, say for a 100 nights, would be?

Mr. MALAM said the cost of the whole apparatus would be very little. The supply of hydrogen might be kept up for several months without renewing. The cost of sulphuric acid is 1½d. per pound, and 1 part in 7 of water was sufficient. He showed how the vessel for generating was self-regulating, and, in reply to a question, asserted that it cost far more to decompose water than to decompose coal. Twenty years ago he had lighted Dumfries for a fortnight by using peats, and had put resin in tins to prevent stokers being scorched while charging, by sliding the tins along the bottom of retort with the peats.

Mr. KEY asked whether £3 would cover the expense of the apparatus on the table?

Mr. MALAM said he had made the whole himself, but thought that sum would cover their expense if they had been bought.

The PRESIDENT remarked that the association was much indebted to Mr. Malam for his description of his ingenious device and well got-up models, the several elegant pieces of apparatus on the table being entirely his own manufacture. The simplicity, charms, and safety of the arrangement render it such that all gas managers who have high lights ought to adopt it and recommend it to others.

A hearty vote of thanks was awarded to Mr. Malam, and that gentleman, in acknowledging the compliment, informed the society that at the next meeting he would give statistics relative to his recent improvements in retorts.

Mr. HALL (Port Glasgow) read the following paper:—

ON MANAGEMENT OF STREET GAS-MAINS, ETC.

In bringing this subject before you, I do so under the consideration that I am not more talented in this matter than the gentlemen now present, but that the subject may be the means of stirring us up to look after one of the most important parts of gas-work management, likewise that it may enable those present to throw out their own individual and practical ideas, as there is great need for us to do something to save in these times, when coal and labour are so high.

If there are imperfect street-mains and improperly watered meters, the loss to small or large companies is made considerable. From what I have suffered myself in that respect, I think I am safe in saying that I have stood highest in point of leakage, both in the past and present situations. I am happy to say, through perseverance, I am overcoming it to a considerable extent. You would scarcely credit that in about 3½ miles of mains, large and small, my leakage has been above 28 per cent. Last year I managed to reduce that to 24 per cent. This year is more favourable; it will be reduced to about 16 per cent., which is still about twice as much as it should be on that length of main, but I hope soon to be able to bring it down to what may be termed a proper average. I will leave it to those who may have any remarks to say what they consider a fair

average leakage. It may be a hard question to decide, for what may be in one town, could not be attained in another, although the class of coals be the same, and the workmanship the same on the mains. With these few remarks, I would say a little on the practical working of, or laying of mains. There is a great want of uniformity of mains, from which the most of you may have suffered. The most of gas companies put down mains merely for the time being, making very little provision for the future, under the consideration of what is called economy, but which is bad economy, and thus diminishing the sizes of the mains too rapidly. In my experience, if gas engineers and gas companies could see their way to lay a continued same size of main from the outlet of their works, through their main street or thoroughfare, to the end of their boundary, the saving effected would be considerable; besides smaller mains would do for the distributing of gas into bye streets, and a greater steadiness of gas to consumers would be obtained, a better illuminating power, better for the meters, less chokage in service-pipes, and have a tendency to reduce the leakage, than what you would have by small mains heavily pressed with gas. Take, for example, three miles of piping. The following is very near how it would generally be laid for supply:—The first mile would be, say 6 inches, from the works; the next three-quarters of a mile reduced to 4 inches; and the next three-quarters of a mile say 3 inches; and the remainder 2 inches in diameter, and the doing so would be a great mistake. Very frequently the greatest amount of consumption has to be supplied through the smallest mains, as it is often the case in towns where localities do rise to that extent, and no provision made for it. Instead of your having the large main first, you would do better to have the small, as it would feed better than distribute. I consider in towns so laid as described, at the extreme and small end of mains, you have a gas two or three candles less in illuminating power than what would be by having a good commodious main where the gas got passed fluently.

The next point I wish to begin a discussion on is the kind of joint for mains that would in the end be the most profitable, and the propriety of being most careful in the workmanship of these mains—I mean whether turned spigot and faucet or spigot and faucet not turned would be best. I prefer the latter, as being the joint that will do the best service. My objections to turned and bored joints are that they are liable to split from jointing or expansion, and they are not safe where there is a heavy traffic, or from any subsiding of roads. If the joints were drawn any, the leakage would be much greater than by a lead joint well yarned. As to the workmanship on mains, I think you will agree with me that small companies lose more from this part of their plant than all the rest combined, and what is the cause? Not from any blame to the manager or gas maker, but to the companies themselves, by not giving full liberty to their manager to look after them himself, but preferring to let them by *contract* for the purpose of saving a few pounds on the first cost. What does Tom, Dick, or Harry care, in fulfilling their contract, how they are laid or what they are like, if they get them under the ground from view, or what the loss of gas may be, if the smell is not disagreeable to passers by? And thus the companies lose themselves and their profits by not giving their managers an opportunity of doing this most important work very thoroughly, because, perhaps, an extra man would be required for a few weeks at a gas-work to allow the manager out to streets.

In the course of my overhauling a main in one street last year, where there was a 3-inch pipe, in 40 joints I had to lay 33 over again. These pipes were not laid by the manager, but under the superintendence of the *superintendent of police*. These things still existed on my entering the situation, but, seeing how matters stood, with stern efforts to make things better, I soon gained the position that every manager of small works should hold if he is worthy of the situation at all. I make these few remarks that we as individual gas managers should stand firm and true to our duty, and obtain our proper rights for the good of the companies we represent, and not have our plans muddled with a class of uninterested and unskilled tradesmen. I found the joints very improperly packed with yarn, which I consider to be the very marrow of the joint; for if the yarn be slovenly put in, and the pipes not large enough to retain their position, the lead gives way, springing and expanding by traffic and weather, and consequent loss by leakage.

There is no difficulty in getting a good substantial joint in an 8-inch pipe, if well yarned and about 1 or 1½ inch of lead, and properly staved in. I have also got the yarn looped over the front of the under side of the faucet. This is done by having too small a faucet hole for working in. In many instances I found the lead not staved at all, only getting a butt with the hammer. There might be a great deal more said upon this subject, but I will not occupy your valuable time to hinder any discussion further than to remark that I attribute to my attention to mains and meters the reduction in leakage during the years I have been manager of Port Glasgow Gas-Works.

Mr. STEWART then addressed the chair. He thought it was very creditable to Mr. Hall to have reduced the per centage of leakage to 16, and remarked that what he called leakage in most cases was gas which passed through the consumers meters unaccounted for, and that in small works gas managers could not give enough attention to its prevention. Where the manufacture was small the gas consumed and lost by leakage not in the mains told greatly. A great difficulty lay with extended lines, and surfaces, and works at a distance from the point of consumption. To have 12 or 13 per cent. of loss might be considered well-managed works. Some got down much lower, but not as a common rule.

Mr. MALAM suggested that the public lamps had something to do with loss by leakage.

Mr. M'LEOD (Glasgow): The subject of joints for pipes is a very much disputed one, and depends on the nature of the ground. I should say, from my own experience and that of other gas managers, that half-turned joints are the best, if the company can bear the expense. Threepence per yard more in the estimates may seem a difficulty insurmountable, but it may involve 10 per cent. of leakage; and the gas manager should not allow himself to be overcome by a directorate who are not acquainted with gas matters. Mr. Hall has said that a short lead joint is more effectual than a long one, but the staving home is difficult. Better to have a long lead joint than a short one not staved home.

The PRESIDENT: I think you misunderstand Mr. Hall's remarks. He said better a good yarn joint, and an inch or inch and a quarter of lead, both well staved, than a short yarn and long lead one slovenly done.

Mr. JEFFREY (Kirkintilloch) remarked he had used turned and bored joints, and had found in his experience that, if the metal on the one side of the faucit was hard in driving home, the spigot would jump off the hard part, and had sometimes been able to insert the blade of a penknife along the one side of the joint when driven up. Cracks frequently occur, too, and in wet weather the pipes fill. He would recommend the joints to be spigot and faucit, and well filled with yarn, and one inch of lead.

Mr. HISLOP (Ayr) said that unaccounted-for gas going under the name of leakage was lost in three ways—through the imperfections of the mains, the consumers meters, mostly where there was no means of ascertaining their condition at the gas-works without sending them to the makers. He had proved this in more places and on more occasions than one. He held that every manager should have the means of testing, and was aware in most small works none such existed, and that there was no means of comparison until the meter came to a standstill altogether. As to joints, he would prefer Mr. Hall's with two inches of yarn and the rest filled up with good lead, and thought, in towns when the average consumption was taken for public lamps, it gave rise to considerable loss. The lighters are not at all interested in the welfare of the company, and all they seemed to care for was to get the lamps lit, and out in the morning. If the consumption be calculated by the hour, they are not at all attentive to time; and it may be observed that those lamps which have the worst burners and smallest light are the meter ones, and are last lighted and soonest out. It is important to see that good burners are in all those lamps.

Mr. BLAIR: I found on one occasion, where the watering of meters was left to a disinterested party, the loss of gas rose from 12 to 16 per cent., and had been as high as 20 per cent.

Mr. RENFREW: As to meter-testing, I had an instance last winter in particular. For the same month of two previous years a dry meter had registered 2400 feet and 2700 feet respectively, but for that month of this year only 900 feet. The consumer said he had used the same lights and gas as formerly. I sent the meter to the maker to be tested, and he reported an error of 3 per cent. against the consumer.

Mr. BLAIR had found a dry meter 25 per cent. slow. The error was reduced to 15 per cent. by grinding the valves. The meter maker then reported 5 per cent. slow, and when it was sent to James Milne and Son, Edinburgh, the meter would not register at all.

Mr. STEWART had seen similar cases. He and Mr. Milne had both found a meter all right, but at the house of the consumer it would not register at all.

The PRESIDENT: Mr. Nelson, seeing you have ceased to be directly interested in the sale of meters, your opinion will be valued by the society. Why do you think this happens? Would you blame tumbling about in transit?

Mr. NELSON said that up to two months ago he had no preference to wet meters over dry. Now, he would not like to throw a prejudice on the former as compared with the latter, but, being urged to speak as if he had no connexion with the matter, he would remark that dry meters were all very well so long as there was proof that they were working accurately; but they had this disadvantage—that they might work long wrongly without it being known. Mr. Scott, the examiner, Glasgow, had set aside 18 of theirs as registering against the company. He (Mr. Nelson) saw four proved, and he was right. But whereas at Glasgow they indicated 1½ per cent. against him, at Edinburgh they were found to indicate the opposite—namely, 1½ per cent. in his favour. They were corrected, but at Glasgow they were still found reversed. He attributed this to transit.

The PRESIDENT: What do you think of the effect of different temperatures of gas, or its having a different composition in the different towns, thus affecting the diaphragms?

Mr. NELSON: The extremes of a cellar or a kitchen will certainly affect them. Dry meters should always be put in a lobby if possible.

Mr. HALL, in reply, said he had found with dry meters generally an unsteadiness of light, and a want of proper indicating, chiefly from misplacement of the cranks. The one was often found drawing against the other, and causing the rising and lowering of the lights. The valves very often did not close properly, allowing gas to pass unregistered; and there was no doubt putting them in a damp place was injurious. His saving of leakage, however, had been chiefly effected by renewing the mains, although there was also a considerable amount by looking after the proper watering of meters. He had found the lead joints of his pipes good to look at; but if he tried to stave them, they would go in very easily, and recommended putting in rope yarn dry, when it would swell on getting damp under ground, but was glad to learn from Mr. M'Leod of the half-turned and bored joints, with a space for lead to front.

Mr. KEY: Mr. Hall's great reduction of leakage must be, I am sure, a cause of substantial acknowledgment, and great satisfaction to the Corporation of Port Glasgow. Beside the loss by public lighting and meters, we have before us the question of leakage from pipes. I have used turned and bored pipes with advantage, where there is little traffic and a good subsoil; but where there was heavy traffic and a small pipe required to be laid, I would recommend lead joints, such as had been already mentioned. Mr. Hall's remarks as to contractors are very just; they are a source of great loss to gas companies who employ such disinterested parties as Tom, Dick, and Harry to lay so vital a portion of the distributing apparatus, with the paltry idea of saving a few pounds in the hundred on first coast. Managers ought to have their own judgment in this matter. Mr. Stewart's suggestions were very valuable. I am afraid there is a great leakage by meters; and Mr. Hislop's remarks as to testing meters by an apparatus at every gas-works may be adopted by those who have not such with profit. As to loss by public lamps, I can testify that at Dumbarton I was surprised to see the amount received for public lighting, considering everything, and on a rearrangement of meters, and adopting four times their number, the next and following accounts were 100 per cent. higher. Of course, one doing duty with such effect may be sure to have a little feeling raised on the point by the commissioners; still I consider the average by meter, where there are no lamp regulators or those not having meters, does not give the average of the amount of gas consumed by the lamps having no meters, and turning direct from the main with full pressure, as so much pressure is absorbed in working the meter, thus lessening the amount at the jet.

Mr. HALL then received a unanimous vote of thanks for his paper.

The PRESIDENT intimated that Mr. Foster, Portobello, had, as yet, not been able to arrive in time for the meeting to read his paper on "Manufacture of Illuminating Gas from Mixture of Oils with Dross, &c."

Mr. HUNTER (Rothsay) read the following paper on:—

MANAGEMENT OF PURIFIERS.

I notice that the title of my paper has been put down as "Management of Purifiers." I do not intend to take this for my text, but purpose giving you my own experience in endeavouring to economize the purifying materials used in the Rothsay works, so that this paper will apply only to that system. I have two dry lime purifiers, each containing four tiers of wood sieves, each tier representing a superficial area of 102 feet; the lime is placed 5 inches deep upon these sieves, and the average quantity I am able to purify is 600,000 cubic feet. I resolved, during the winter, to make some experiments for the purpose of finding if it was not possible to discover another agent to assist the lime, and after some fruitless efforts it struck me that the furnace refuse may be of some assistance; so I substituted it on the first or topmost tier of my sieves, and caused the gas to pass through it downwards, and I found that I was able to purify the same quantity of gas at a saving of 25 per cent. of lime. I found afterwards, when the clinker was broken small, it was the most effectual; care must, however, be taken that the rough or course danders are not allowed to collect in one place, or at the sides of the purifiers, as the gas will be allowed to pass without coming into contact with the finer ashes.

I do not allow the purifier to work after the slightest mark appears on the test paper, but immediately order it to be cleaned. I may say that, as you are all aware, when the purifier is newly charged with lime, the lime does not at once absorb the impurities. I find with the ashes that the purifying process begins much earlier.

The coal I used during the winter was Lesmahago and a splint, both very well charged with sulphur.

I consider that the expense of purifying depends greatly upon the cost of the lime, upon the price received for the residue or waste lime, and also to a certain extent upon the class of coals you carbonize, as upon one occasion I found on using a certain splint I could scarcely pass 30,000 before the test showed sulphur. This was before I tried any experiments, and, in fact, was the means of drawing my attention to the matter. However, if actual cost is a criterion, as to a certain extent I admit it is, my present average is ·92d., or almost 1d. per 1000 cubic feet.

I have not been able to prosecute this matter any further, but I hope these simple remarks of mine may be the means of drawing your attention to the

subject, and some of you, who may have a better opportunity, might find it to your advantage to look into the matter, and give it the consideration which, in my opinion, it deserves.

Mr. SMITH (Helensburgh) said he had used coke in a similar way. He had four purifiers, three he used for purifying, and the fourth was connected so that he passed all his gas from the condensers through it first. It was filled on each sieve with coke as a scrubber, and before doing so he had to lift the cover of the purifier that was entered first from the condensers every six hours—the first time to loosen with a shovel, next time to lift out first sieve, then next time would have to clean out purifier altogether. Since using the coke scrubber he had never had any more than the ordinary cleaning of purifiers, and the coke on being taken out for renewal was after a time used in the furnaces, whereas the ashes of furnace, if used as Mr. Hunter had mentioned, he could not have got rid of them.

The PRESIDENT: You have not quite sufficient condensing power, and your purifiers are quite close to condensers?

Mr. SMITH: Yes.

The PRESIDENT: Mr. Hunter I think has quite ample condensing power, therefore the question is that of the purifying capabilities of the ashes and dander as stated by him. I think the communication an important one, since out of every four sieves of lime one is saved, and the pit ashes substituted to clean the same amount of gas, thus 25 per cent. of lime is saved.

Mr. HALL: Do you damp the ashes same as lime?

Mr. HUNTER stated they were damp when taken from the pits and put in a place to receive them, and were used so soon as required.

Mr. STEWART thought it would be important for each member to experiment, and report at next meeting.

A cordial vote of thanks was accorded to Mr. Hunter.

A donation of £1 to the managers fund was intimated as having been received during the meeting.

Mr. Malam was repeatedly called on to exhibit his carburetted air gas by lighting it, and his arrangement for lighting high lights, to the evident satisfaction of all present.

After some very useful conversation, the members and friends proceeded by the waggonettes in waiting for them to visit Burns's monument and cottage, and the other interesting scenes in the locality, returning to Ayr at four p.m., and dining together in "Goudie's Restaurant"—Mr. KEY in the chair, and Mr. STEWART (Greenock) croupier. A very happy afternoon and evening were spent.

COMMERCIAL ILLUMINATING GAS FROM CRUDE PETROLEUM.

By WM. H. SPENCER,
Inventor of the "Spencer Process."

In commencing this sketch of the philosophical and chemical principles which govern the process of gas manufacture from crude petroleum, a few remarks on the nature of the business and its estimation in the eyes of the fraternity will not be untimely. Success rarely falls to the lot of a man whose business is imperfectly comprehended. A merchant dealing in commodities of whose nature and qualities he is ignorant, or still worse, but superficially acquainted with, starts in an unequal race with him whose judgment is governed by the knowledge due to years of familiarity with and observation of his wares. But still more hazardous is the position of a man who enters upon the field of invention, and particularly that embodying chemical principles, general as well as special, and in which any end attained simply forms one member of a series of influences, some easy of comprehension, others quiet, silent, but frequently the most potent of all; and the whole bound and netted together, each in its proper place, and working unerringly, in its own way and time, to bring about certain definite results.

The discovery of any new substance or principle is rarely, if ever, the result of accident or chance, but commonly, if not always, the result of labour, patient and understanding.

In these days science has deemed nothing too mean to command her respect and attention, and every step in every branch of industry has been subject to her scrutiny. In every operation which ministers to the luxuries or necessities of our later civilization, science has first mastered the underlying principles, that it might dictate the course of the future.

This is legitimate invention, but there is another class of men laying claim to the name of "inventor," whose influence has well-nigh made that name a reproach. I refer to a class, some honest, others knavish, who spurn the elementary steps, and grapple with the perfected idea. They call themselves *practical men*, and in so doing belittle an honourable title, for a truly practical man cannot be overvalued. Their motto is, "Results! Facts." To them science is book-learning, and worthy of all condemnation. They ignore demonstration, and let their *finished work* speak for itself. Probably no branch of industry has been more subject to the efforts of these man than the manufacture of illuminating gas, and especially its manufacture from petroleum. They appreciated the fact that it was delightful to suppose that gas almost ready made, condensed to a liquid to allow of transport, flowed steadily from the earth. They likewise knew that it was a great temptation to a man to offer him, for a comparatively small sum, the monopoly of a process by which the finishing touch could be added to Nature's uncompleted work; and as *practical* men who scorned to give reasons for *facts*, they appealed to men to whom "seeing is believing," and the result was the production and sale of a mass of "inventions" for making gas from petroleum, every one of which would make gas, and *good* gas, but not one of which could come into anything like general use; the upshot of the whole thing being the condemnation of the "inventors," and the firm conviction, on the part of the victimized, that gas cannot be made from petroleum.

Following out our own doctrine, we offer the above as *reasons* for the *fact* that a strong prejudice does exist against "petroleum gas;" and, as owing to that prejudice it has been said that "commercial illuminating gas cannot be made from petroleum," we propose to briefly sketch the "reasons" which, during the past 18 months, have led us to believe that it can.

The first point that demands our investigation is the

Nature and Composition of Crude Petroleum.

In describing this I cannot do better than to quote entire the description given of it by our ablest working practical chemist, Professor C. F. Chandler, in his report to the Board of Health for 1870:—

"Crude petroleum, as it comes from the wells in Pennsylvania, is generally a dark greenish-brown liquid of a somewhat offensive odour, varying in specific gravity or density from ·820 to ·782, or 40° to 48° Beaume. It is chiefly a mixture of a great number of hydrocarbons—compounds of carbon and hydrogen—the average proportion of the two elements in the mixture being—

Carbon	85 per cent.
Hydrogen	15 „
	100

"These hydrocarbons differ from each other in volatility. Some are so volatile as to evaporate rapidly at ordinary temperatures, making it dangerous to approach an open tank of petroleum with a flame; others are much less volatile, requiring a temperature of 700° to 800° Fahr. to vaporize them."

The volatility of these component hydrocarbons is intimately related to their specific gravity or weight, the lightest ones being the most volatile, while the heavier oils possess the higher boiling points.

The lighter oils in petroleum belong mostly to the group of hydrocarbons known as the "hydrides of the alcohol radicals," or "marsh gas series." The heavier oils are believed to belong to the "olefines," or "ethylene" series. Neither of the groups have been fully studied, and the exact constitution of the heavier portions of petroleum has yet to be determined.

TABLE I.

Names.	Formulæ.	Carbon.	Hydrogen.	Boiling Points.	Specific Gravity.
Marsh gas	$C H_4$	75·0	25·0	A gas	—
Ethyl hydride	$C_2 H_6$	80·0	20·0	„	—
Propyl „	$C_3 H_8$	81·81	18·19	„	—
Butyl „	$C_4 H_{10}$	82·80	17·20	32°F.	600
Amyl „	$C_5 H_{12}$	83·33	16·67	86 „	628
Hexyl „	$C_6 H_{14}$	83·72	16·28	154 „	669
Heptyl „	$C_7 H_{16}$	84·0	16·0	200 „	699
Actyl „	$C_8 H_{18}$	84·21	15·70	248 „	726
Nonyl „	$C_9 H_{20}$	84·38	15·62	279 „	741
Rutyl „	$C_{10} H_{22}$	84·51	15·49	320 „	757
Endecyl „	$C_{11} H_{24}$	84·61	15·39	358 „	766
Laurel „	$C_{12} H_{26}$	84·70	15·30	390 „	778
Cocimyl „	$C_{13} H_{28}$	84·78	15·22	426 „	796
Myristyl „	$C_{14} H_{30}$	84·85	15·15	460 „	809
Benyl „	$C_{15} H_{32}$	84·90	15·10	511 „	825
Palmityl „	$C_{16} H_{34}$	84·96	15·03	536 „	—

TABLE II.

Names.	Formulæ.	Carbon.	Hydrogen.	Boiling Points.	Specific Gravity.
Ethylene	$C_2 H_4$	85·71	14·29	A gas	—
Propylene	$C_3 H_6$	85·72	14·28	„	—
Butylene	$C_4 H_8$	85·71	14·29	„	—
Amylene	$C_5 H_{10}$	„	„	103·0°F.	627
Hexylene	$C_6 H_{12}$	„	„	169·8 „	—
Heptylene	$C_7 H_{14}$	„	„	210·2 „	718
Octylene	$C_8 H_{16}$	„	„	257·0 „	—
Nonylene	$C_9 H_{18}$	„	„	—	—
Paramylene	$C_{10} H_{20}$	„	„	329·0 „	777
Triamylene	$C_{15} H_{30}$	„	„	473·0 „	814
Tetramylene	$C_{20} H_{40}$	„	„	743·0 „	871

Table I. shows the compositions, boiling points, and gravities of the members of the first group, or marsh gas series.

Table II. shows the compositions, boiling points, and gravities of the olefines, or ethylene series.

The first or lowest members of each series are gases at ordinary temperatures, the intermediate members liquids, and the highest solids.

It will thus be seen that, so far from being homogeneous and uniform in its changes, petroleum is one of the most complex of natural compounds, and the action of its compounds under heat, so far as exact determination is concerned, is beyond the power of modern science.

There are, however, certain general laws to which both series of hydrocarbons just tabulated will conform, the one immediately concerning our present subject being that the higher members of each series, subjected to a heat beyond their boiling points, assume the likeness of the lower members, and remain gaseous at ordinary temperatures. This principle may be stated in the language of Wohler, the German chemist: "Organic bodies undergo the most varied changes when subjected to the action of high heat. . . . One organic body is separated into two new ones under the influence of heat, or there is formed at the same time a larger number of new organic compounds, which in their turn are often destroyed at the moment of their formation, thus giving rise to a complicated mixture of products, generally ending in leaving behind a residue of carbon. These products are different, according as the heat is more or less strong, slower or more rapid."

Warren, in submitting to the American Academy his report of the investigation of petroleum by himself and Mr. Storer, says that, on account of the complex nature of that substance and the circumscribed limits of temperature in which its components can exist, it is almost impossible to regulate the heat applied so as to avoid destructive distillation.

Therefore, in subjecting petroleum to the heat used in gas-making, we must conceive of its undergoing a multitude of chemical changes in a moment of time, the higher members of each series falling rapidly, yet by successive steps, towards the lower or gaseous members, which are alone able to exist at the temperature employed.

In this view of the case it is obvious that there is a temperature at which the gas made from petroleum will consist of the lowest members of two series of hydrocarbons, or at least containing the same properties of hydrogen and carbon found in the original petroleum.

We know this from the fact that by careful watching we may change a gallon of petroleum into gas with comparatively little deposition of carbon; probably with no deposit, were it possible to control absolutely the action of the heat. It is obvious, therefore, that when the object is to obtain the full value of the oil, as gas, the economy varies as the heat used approaches this degree; or, in other words, it is desirable to retain as much of the carbon as is possible in the state of gaseous combination with hydrogen, in which case the hydrogen as a vehicle is able to transport the carbon without obstructing the pipes used to convey it, while if by reason of an excess of heat the carbon is dropped, it must remain as an obstruction in the shape of lamp-black, it being unable to recombine with hydrogen. This is the explanation of the formation of the rich petroleum gas known to the fraternity, consisting of hydrogen loaded to its fullest carrying capacity, or less, with carbon, as it has been carefully or carelessly made.

But in our consideration of the manufacture of commercial illuminating gas from petroleum we must go still further, for the product just described can lay no claim to that title. It remains, therefore, to consider the conduct of this gaseous compound under a temperature exceeding that used in its formation. The first important change effected by such an elevation of temperature is to change the members of the olefine series contained in the mixture to those of the marsh gas series. This change is effected without change of bulk, each atom of the olefines dropping half its carbon and becoming an atom of the marsh gas type. Thus, $C_2 H_4 - C = CH_4$. This deposition of carbon will, of course, be exactly in proportion to the number of members of the olefine series contained in the compounds, and unless the deposition takes place in the presence of a body like oxygen, which is capable of appropriating the free carbon, it will remain as an impalpable powder resembling lamp-black.

Having thus reduced our compound to the lowest members of the marsh gas series, the last step in the decomposition remains to be taken, which consists in the reduction of these to their elements leaving free hydrogen and free carbon. This final change is accompanied by a somewhat remarkable phenomenon. The gas under treatment *doubles in volume* and *loses three-quarters of its weight*. This is owing to the fact that in gaseous combinations of carbon and hydrogen the mixture occupies but *half* the volume that the *hydrogen alone* would occupy if *free*. Our hydrogen, obtained from petroleum, having thus far been in combination, it follows that being set free by deprivation of its carbon it doubles its volume. (It may be stated that in the course of this last operation traces of three other hydrocarbons are formed synthetically; they, however, are unimportant in our present research.)

Having thus considered petroleum in all the Protean forms which it assumes under the influence of heat, we proceed to consider the numerical value of the products obtained.

A gallon of average petroleum has a specific gravity of ·800, water being 1. A standard gallon of water weighs 58,372 grains; therefore a standard gallon of such petroleum would weigh 8-10ths of that, or 46,698 grains. We have already stated that petroleum is composed of 85 per cent. carbon and 15 per cent. hydrogen by weight, consequently one gallon of petroleum has the following constitution:—

One standard gallon of petroleum of specific gravity ·800 weighs 46,698 grains,

85	per cent. of which =	39,693·3 = carbon.
15	„ „ =	7,004·7 = hydrogen.
100		46698·0

We knew that one grain of hydrogen measures 44·14 cubic inches, or ·02554 cubic feet. (All the following calculations of volume are reduced to the French standard barometer 760 mm., thermometer 0° Centigrade; or [English] barometer 29·92 inches, thermometer 32° Fahr.) Consequently our 7004 grains will equal a volume of 178·8 cubic feet.

(As illustrating the conformity of theory with practice, bear in mind that prior to the last step in the decomposition, this 178·8 feet of hydrogen was contracted to half that bulk, or 89·4 cubic feet. This corresponds very nearly to the yield of rich gas obtained from a gallon in actual practice; the figures ranging from 80 to 90 feet.)

Retracing our steps a little, it will be remembered that in referring to the rich gas obtained from petroleum, we stated that it could not be called "commercial gas." That it will burn no one doubts, and that properly consumed it will surpass coal gas in illuminating power cannot be denied; but it is heavy, and the flame, consequently, lacks the steadiness so desirable in illumination. Its production is slow, and requires far more care, and gives far more trouble than coal. Burners and meters that will give satisfaction with coal gas require to be changed; but the vital objection is its cost. It is too expensive. With oil at 10 cents., and a yield of 85 feet to the gallon, material alone costs 1·20 dol. per 1000 feet, which, with labour and other expenses added, would prohibit its use. But the suggestion is made, if your 85 feet of gas is of 90-candle power, why not dilute it; sacrifice some of the illuminating power and get a greater volume. Just here hinges the whole question of gas manufacture from petroleum in this question of dilution.

In his search for available diluents the inventor finds his material speedily reduced to one of two things, atmospheric air and hydrogen being the only ones approaching possibility, and both of these up to the present time being unavailable.

Dilution with air, one need scarcely add, has been faithfully tried, and signally failed. At Saratoga and Memphis the "Rand process," under the absolute control of its inventors, failed of achieving success. The causes of failure were—

1. That petroleum gas mixed with air is of nearly the same weight as the air itself, and the flame vacillates and is liable to be extinguished by draughts of air which would scarcely affect coal gas.

2. Be the mixture made ever so carefully, there are times when the one or the other ingredient will predominate, and the flame either smoke or burn blue; and,

3. Petroleum gas cannot be diluted with air to a sufficient extent to be made profitable, for the reason that air has a *direct action on the luminosity of the gas* aside from its mechanical action as a diluent. And be the petroleum gas as rich as it may, dilution with 40 per cent. of atmospheric air is all it will stand; or, in other words, you can get 119 feet of the mixture from a gallon of oil, which cannot compete with coal gas in quality or price.

Without pausing to consider the reasons for this action on the luminosity of flame, further than to say that if we accept the hypothesis that the luminosity of a flame is proportioned to the temperature to which its particles of carbon are exposed, we may account for this undue depreciation of the light by considering that of the 40 per cent. of air added to the gas, nearly 32 per cent. is nitrogen, which must be heated, although it affords no light.

Our list of available diluents then is reduced to a single member—hydrogen. This substance chemically fulfils all the requirements of a diluent. Coal gas itself consists of a small quantity (4 to 7 per cent.) of the same illuminants which make up the bulk of rich petroleum gas, diluted with hydrogen and light carburretted hydrogen (whose light-giving power is practically nothing) to the extent of 85 to 90 per cent., the balance consisting of impurities.

But while hydrogen answers the physical demands of a diluent, it has hitherto failed commercially, the cost of production being prohibitory.

Cheap hydrogen for gas dilution has occupied the attention of inventors since 1830, when, I believe, the first English patent was granted to Michael Donovan, and which was the forerunner of a hundred others.

The method by which these inventors endeavoured to obtain hydrogen was almost universally by the decomposition of water, a few employing electricity and chemical reactions for this purpose, but the majority relying on high temperatures and the action of oxidizable matter, as carbon or iron, the principle being that the oxygen of the water at a high temperature has a greater affinity for carbon, iron, zinc, &c., than it has for the hydrogen, with which at ordinary temperatures it is so strongly united, and in uniting with them to form the respective oxides, releases hydrogen varying in amount with the combining members of the material oxidized; zinc, for example, yielding about 6 cubic feet of hydrogen per pound, iron about 8, while carbon yields either 20 or 60, as the oxygen combines with it to form oxide or dioxide.

From the foregoing figures it will be seen that carbon is by far the best material for practical use, not only by reason of the larger yield, but on account of its cost. The hydrogen produced by the metals, however, has the advantage of being comparatively pure, the oxides being solid and remaining in the retort, while oxides of carbon are gaseous and mix with resulting hydrogen, the dioxide or carbonic acid being separable from the mixture, while purification from oxide or carbonic oxide is commercially impracticable.

But there is still another difficulty which practically prohibits the use of the metals, and which, though, to my knowledge, not hitherto urged against carbon as commonly used, yet, as will be seen, *does* powerfully prejudice its use.

I refer to the fact that in each case *all* the material put into the retort is not available, and to the still more important fact that the production of hydrogen is by no means uniform or regular. In the case of the metals, a familiar example will explain the reason of this. Every one has noticed the rapidity with which a clean iron surface rusts or oxidizes under the influence of the air. Now, were this superficial film of oxide removed as fast as formed, and a new surface presented to the air, the metal would rapidly waste away; but, allowed to remain, it shields the underlying metal, and the action of the air is slower in proportion to the thickness of the protecting layer. Just so it is when the metal is placed in a retort and exposed to the oxygen of the water. Oxidation takes place rapidly at first, but as the layer of oxide is formed the action is retarded, until, long before the metal is consumed, the process becomes too slow to warrant the expenditure of fuel.

Carbon is likewise protected, though from a different cause, owing to the fact that in all the forms of charcoal, coke, peat, or anthracite in which it has hitherto been employed, it contains a large per centage of foreign matter, which is unaffected by heat or oxygen, known in every-day life as ash or clinker. These impurities are distributed more or less uniformly throughout the mass of each particular lump of coal, coke, or charcoal; but, as the oxygen discriminates unerringly in favour of the pure carbon, they are left behind, shielding the carbon beneath with a coating of ash against the desired action of the oxygen. These impurities vary in the different forms of carbon employed, and in different samples of the same form. Wagner, in his "Chemical Technology," gives samples of charcoal in which carbon forms but 66 per cent. of the weight; of peat containing as little as 47 per cent., and one sample of which the ash constitutes 56 per cent.; of anthracite in which carbon forms but 85 per cent. by weight, the light flocculent ash forming a large bulky residue.

The only figures I am able to obtain in relation to the matter are those of Professor Silliman, in his report on the "Gwynne-Harris Process," where anthracite was used, and in which 25 per cent. of the anthracite put into the retorts was unconsumed. I have purposely dwelt on this last point in detail, for the reason that it affects the vital considerations of cheap hydrogen manufacture—speed, regularity of production, fuel, and labour; these, far more than cost of material, are the rocks upon which so many have split. The fuel must be bought, freighted, stored, handled, and consumed, be the production rapid or tardy. Every minute spent in handling waste material, every degree of heat to which such material is raised, and every minute that the retort lies idle, has a value.

Manifestly, then, the purity of the carbon used in the decomposition of water is intimately connected with the commercial success of the operation; but the object being to produce the greatest quantity of gas in the least time, it follows that every opportunity should be allowed for the intimate contact of the two substances; for while the oxygen has a decided chemical affinity for the carbon, yet there is no mechanical affinity, neither has either element any semblance of magnetic power over the other. *Contact* is essential to combination, and that contact must be brought about mechanically. Hitherto it has been facilitated by disposing the carbon on perforated trays, the steam in its course being admitted beneath, and rising through the layers. Remembering that the oxygen which is brought into actual contact with the carbon is utilized, the importance of bringing each particle of oxygen admitted into the retort into contact with a particle of carbon is evident, each atom of steam passing through *without* such contact representing a total waste of labour and fuel employed in its production.

This may be exemplified by the case of a sportsman who shoots at a bird with a charge of one hundred shot, one of which kills, while ninety-nine are wasted, the dead bird representing the value of the whole one hundred. So, if we have, for instance, 1 lb. of carbon, which 1 lb. of oxygen will completely absorb, and yet are obliged to use 100 lbs. of oxygen to get one effective pound, it follows that the cost of our product is that of the whole 100 lbs. in labour, fuel, and time.

The extent to which this juxtaposition may be effected depends on the size of the carbon particles employed; the smaller the atoms the more intimate the mixture.

Carbon, of course, may be readily pulverized by mechanical means, but in common with some other substances it can exist in a number of different states, as diamond, graphite, lampblack; this last being its most finely divided modification, and, aside from the diamond, its purest state.

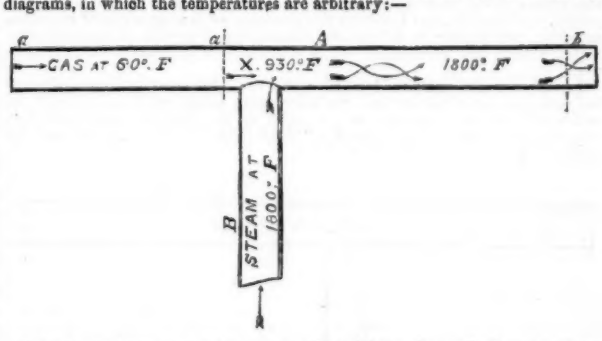
It follows, then, from what we have said, that this form of lampblack is best suited to its use in the manufacture of hydrogen; which is true, but heretofore the mechanical and economic objections have proved insuperable. Returning to the consideration of petroleum as a material in gas manufacture, it will be borne in mind that we had traced its modifications by heat to the point at which the elements stood apart, the gaseous constituents represented by 178·8 cubic feet of hydrogen, while the solid carbon formed 85 per cent. of the entire weight, or 39·688 grains, equivalent to 5·67 lbs. This carbon is as nearly pure as carbon can be obtained, and the plan followed in obtaining it corresponds exactly to that of the chemist to whom purity of material is essential. Moreover, it is very finely divided, nearly as much so as lampblack, and equally difficult of manipulation. If this substance were placed in a retort, its purity would be in its favour; but as, owing to its fineness, perforated trays would be impracticable, it would of necessity rest in a layer upon the bottom, its upper surface being alone available, unless indeed the mechanical action of the steam should carry the fine dust with it, eventually obstructing the whole apparatus used in the operation.

If we could store and handle it, and feed it into a retort just as it was wanted, diffusing it in an impalpable powder at a white heat through the whole mass of white hot steam, being able to regulate the proportions of material with ease and exactitude to each other, and to our heat, thereby rendering decomposition instantaneous and complete without residue, we should manifestly be using carbon to its very best advantage.

This we can do, and in our ability, as demonstrated and sustained in practice, to accomplish these results simply, rapidly, and cheaply, we rest our claim of manufacturing "commercial illuminating gas from crude petroleum."

The method of accomplishing this is very simple when it is remembered that rich petroleum gas is simply hydrogen overloaded with carbon, and containing all the carbon that we see produced as a black powder by ultimate decomposition. Yet this carbon is not visible, and the gas so rich in it is clear and transparent, and we may store it, carry it through pipes, and regulate its flow, as though it were water.

The groundwork of the whole principle may then be summarized as making the hydrogen carry the carbon in a gaseous state to the place desired in just the quantity needed, and then and there to drop it in a *solid* state. This absolute control over the carbon being the essential to success. I cannot better demonstrate the importance of the statement just made than by the following diagrams, in which the temperatures are arbitrary:—



Let A. B. represent two tubes connected at right angles, and whose temperature between the dotted lines *a b* is 1800°. Gas at the temperature of the air, say, 60° Fahr., enters at *c* in the tube, and mixes with steam at 1800° Fahr. at the point *x*. The temperature of the mixture at the point *x* is vital, as affecting successful decomposition, owing to the fact that rich gas will deposit carbon of a lower temperature than that at which carbon will decompose steam.

In the case before us the control of the temperature is simple and effective, being effected by the quantity of each ingredient supplied at the point *x*.

In case of gases (steam at 1800° being practically a gas) and leaving out the question of specific heat (which in this case may be assumed to be nearly equal in each ingredient), the temperature of the mixture varies directly with the weight of each ingredient: thus 1 lb. of gas at 60° Fahr., mixed with 1 lb. of steam at 1800° Fahr. would equal 2 lbs. of mixture having a temperature of

$$1800 + 60 = \frac{1860}{2} = 930°.$$

If the gas is in greater proportion, say as 2 to 1, the temperature of the mixture will be 640°; while, if the steam be to the gas as 2 to 1, 1220° will be the temperature of the united gases.

Now suppose that 930° be the lowest degree at which oxygen will forsake hydrogen for carbon (and in practice this approaches truth), and consequently the lowest degree permissible at x, it follows that the weight of gas admitted may equal but not exceed the weight of steam, while it may be as much less as desired. Any *excess* of gas being manifested by the deposit of free carbon at x, and as it is perfectly easy to maintain a steady flow, day in and day out, both of steam and gas, it is only necessary, in operating such an apparatus, to adjust the temperature of the mixing point to a degree sufficiently high to allow for the ordinary slight variations of temperature and pressure. Thus, suppose 1800° to be the temperature at the moment of adjustment, and 930° the lowest degree permissible in the mixture, mix your gas and steam as 1 is to 2, thereby setting the temperature at x up to 1220°, which no ordinary variation could reduce below 930°.

Just here may be shown effectively the vast difference between the method under consideration and those processes, of which I can recall 30 or 40, in which the *vapour* of petroleum is used in somewhat the same way.

These have failed, and of necessity always will fail, by reason of the enormous quantity of heat rendered *latent* by the change of petroleum from a liquid to a gaseous state. Theoretically all matter can exist in three different modes, solid, liquid, and vaporous; and, moreover, there is a fourth state, the gaseous. These changes are effected or maintained by temperature; thus, iron being a solid, at, say, 2700° Fahr. is a liquid; water at 32° Fahr. is solid, a liquid from 32° to 212° Fahr., and above that vaporous.

Now these various modes of matter and the transition from one to another have received the closest attention from our most eminent scientists, and the most important result of research has been the demonstration of the fact that each change from solid to liquid and liquid to vapour is accompanied by apparently a great loss of heat.

Of all substances water is the most marked in this respect, and I cannot do better than use it as an example.

Suppose a pound of water and a pound of iron to be at zero, to each of them attach accurate thermometers, and expose each to exactly the same amount of heat (setting aside the question of their specific heat, and supposing it to be equal in each, however widely it differs in reality).

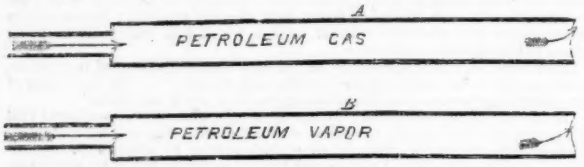
The thermometers will rise steadily and together to 212°; at this point a remarkable change takes place. The thermometer in the water remains stationary, while bubbles of steam rise from the surface. If a third thermometer be held in the steam, it too will indicate 212° and no more, showing that the liquid and the vapour have the same temperature. Any increase of heat only increases the speed of ebullition, the temperature stubbornly refusing to rise so long as a particle of liquid remains. On the other hand, the thermometer attached to the iron makes no halt at 212°, but moves on steadily until, when the water has completely boiled away, it stands at 1178° Fahr.

How can it be that the same amount of heat applied to these two substances for the same time has raised the iron 966° Fahr. above the water? Simply in this way: Each substance has received the same amount of heat (1178°), but of this the water has used or rendered latent 966° in effecting the change from liquid to vapour.

What is true of water is also true of every substance wherein a change of state can be effected.

Without going into the question of the difference or identity of the vaporous and gaseous states, or inquiring, in the case of petroleum, as to whether the change from the one to the other is a true chemical decomposition, or simply molecular, I will simply make the statement that when petroleum vapour becomes petroleum gas a large amount of heat is rendered latent.

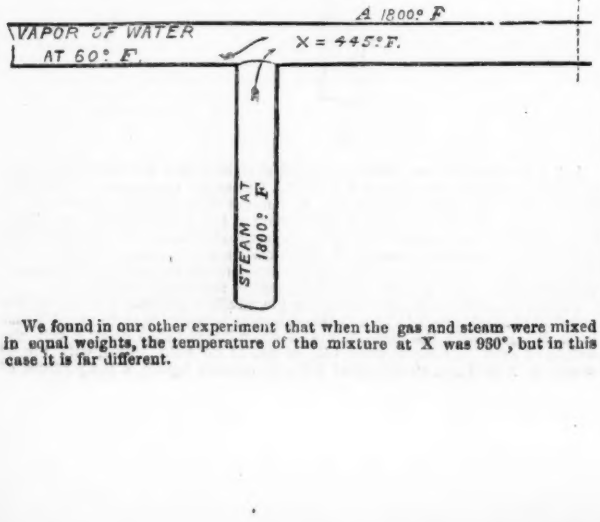
This is every-day experience in the manufacture of petroleum gas, and may be readily proved by any one who will construct an apparatus like the following:—



Let A B be two retorts in the same furnace, and exposed to the same heat Through A conduct a stream of gas, and through B a current of vapour, both gas and vapour being at, say, 210° Fahr., and let the same weight occupy the same time in passing. The retort B will be somewhat cooler than A, owing to the greater specific heat of the vapour.

Now gradually increase the heat on both until the vapour in B changes to gas, and note the effect. B will suddenly cool far below the temperature of A, the reason being that while the gas in A demands heat only to maintain a certain temperature, and indicates the accession of heat by a rise of the thermometer, the vapour in B demands besides heat to be used in internal work, which, though not perceptible by any instrument of measure, is none the less real.

I now propose to apply the law just stated to the explanation of the difference between the use of vapour and gas in hydrogen manufacture, and in so doing will reproduce the diagram, and use water as an illustration, the conditions being exactly the same, the gas at 60° Fahr. entering at C being replaced by aqueous vapour, also at 60° Fahr.



We found in our other experiment that when the gas and steam were mixed in equal weights, the temperature of the mixture at X was 930°, but in this case it is far different.

When we mixed the steam and gas, the surplus heat of the steam had nothing to do but raise the sensible temperature of the gas, while in the present instance the vapour of water turns 1118 units of heat to internal work, and shows for this large quantity of heat a rise of but 152°, or a pound of steam at 212°, and of the 1800 sensible units of heat contained in our superheated steam it can spare but 1585, lest it itself be condensed, therefore the whole amount of available heat which can be used in raising the mixture above 212° is 1585—1118 = 467°, and the temperature at × becomes $212 + \frac{(212 + 467)}{2} = 445°$, or nearly 500 degrees less than when no heat was required for internal work.

I do not wish to be understood as saying that in the case of petroleum vapour the difference will be as great as in the case just quoted, but that in all cases where the available heat units are limited, and the greatest possible sensible temperature a desideratum, it must be borne in mind that the less the internal work effected in either constituent of the compound the higher will be the resultant temperature.

Having thus in detail canvassed the physical advantages of this carbon used in this way, let us briefly glance at the possible numerical results.

It will be remembered that after obtaining 178·8 cubic feet of hydrogen from our gallon of petroleum we had 5·67 pounds of carbon remaining, which, being used to decompose steam, would give different quantities of different gases as carbonic acid or carbonic oxide may be formed. We can readily show this, using pounds as a unit:—

Carbon.		Water.		Heat.		Carbonic Oxide.		
C	+	H_2O	+	Δ	=	CO	+	H_2
12 pounds						12 + 16 = 28 lbs.		1 + 1 = 2 lbs.

or 12 lbs. of carbon combined with 18 lbs. of water will make 28 lbs. of carbonic oxide and 2 lbs. of hydrogen. Now, knowing that 1 lb. of C O measures 12·77 cubic feet, and 1 lb of hydrogen measures 178·8 cubic feet, we see that

12 lbs. carbon and 18 lbs. water = { 357·56 cubic feet C O.
357·56 „ „ H.

1 lb. carbon + 1·5 lb. water = { 29·79 „ „ C O.
29·79 „ „ H.

or 59·58 cubic feet

of the above gases in equal proportion, and the result of turning our gallon of petroleum into gas of this kind would be as follows:—

Hydrogen originally existing in the petroleum	178·8 cubic feet.
Hydrogen obtained by decomposing water with 5·67 lbs. of carbon	168·9 „
Carbonic oxide obtained by decomposing water with 5·67 lbs. of carbon	168·9 „
or,	516·6 „

of a mixture containing by volume 60 per cent. of hydrogen, 30 per cent. carbonic oxide.

When the 5·67 pounds of carbon is converted into carbonic acid, the result is as follows:—

Carbon.		Water.		Carbonic Acid.		Hydrogen.
C	+	2 (H_2O)	=	CO_2	+	H_4
		2 (2 + 16 = 18) 36 lbs.		12 + 32 = 44 lbs.		4 lbs.

And as 1 lb. carbonic acid . . . . = 8·12 cubic feet,
And as 1 lb. hydrogen . . . . . = 178·8 „

It follows that 12 lbs. of carbon + 36 lbs. of water = { 357·5 cu. ft. carbonic acid,
715·2 „ hydrogen;

0·1 lb. carbon + 3 lbs. water . . . . . = { 29·79 „ carbonic acid,
59·6 „ hydrogen;

or, 89·39 „ of a mixture

of the above gases in the proportion of 1 to 2, and the result of turning 1 gallon of petroleum into gas of this kind would be as follows:—

Hydrogen originally existing in petroleum	178·8 cubic feet.
Do. obtained by decomposing water with 5·67 lbs. carbon	337·9 „
Carbonic acid obtained by decomposing water with 5·67 lbs. carbon	168·6 „
or,	685·6 „

of a mixture containing by volume 77 per cent. hydrogen, 23 per cent. carbonic acid.

Comparing the results of the above analysis, we see that the volume of gaseous products obtained from a gallon of petroleum when the carbon forms carbonic acid (685·6) exceeds that obtained when carbonic oxide is the result (516·6) by 169 cubic feet, but the entire 516·6 feet is a combustible gas, and suitable in every physical way for a diluent without purification; the larger volume (685·6) feet contains 23 per cent. of a gas noted for its power in checking combustion and decreasing the luminosity of flame.

In favour of the latter, however, it may be urged that this carbonic acid can be removed with comparative ease and economy, leaving an amount of pure hydrogen, equal to the entire volume of the mixed products of the first decomposition (516·6 feet), which product contains 30 per cent. of a gas which cannot be removed practically, and which, while it aids combustion, is an active and virulent poison when inhaled, for which reason a leaky gas-pipe would be doubly dangerous.

Without discussing the merits of this question further than to confess to an agreement with those who claim that a leaky gas-pipe is dangerous any way, and not to be tolerated, we will simply state that in both points of view, sanitary and economic, the change of carbon into carbonic acid is preferable, as if carbonic oxide is objected to we can purify our gas and supply 516·6 to the gallon of pure hydrogen, while if it is not an objection, we can readily convert our carbonic acid into carbonic oxide by several cheap and well-known methods.

Unfortunately, however, the gas manufacturer has hitherto had "Hobson's choice" in the matter, and been compelled to take both and submit to the disadvantages of both, and to spend time and money in purifying or converting without the satisfaction of an unobjectionable product in either case.

In the present plan, however, this is changed, the carbon in every case assuming the form of carbonic acid.

This is readily accounted for when we know that carbon will always take two atoms of oxygen when it can get them, forming CO_2, or carbonic acid; but if it cannot get two it will content itself with one, forming CO, or carbonic oxide; and carbon, moreover, is, so to speak, a generous body, for if an atom of red-hot carbon, carrying two atoms of oxygen, meets another glowing atom having no oxygen, it divides with it, and the two travel on together as two molecules of carbonic oxide; thus $CO_2 + C = CO + CO$.

The practical working of this tendency of carbon will be readily apprehended when it is remembered that in all plans heretofore adopted the carbon is vastly in excess of the oxygen present in any one time in the retort; and, moreover, that any carbonic acid formed at the first contact of carbon and steam is compelled in its passage to traverse a bed of red-hot carbon.

In our case, however, the conditions are reversed, and at the moment of decomposition the oxygen is always in excess of the carbon, while in its passage to the outlet of the retort (clay) the carbonic acid meets no substance capable of effecting its decomposition.

We have thus carried our investigation far beyond the point intended at the outset, led on from detail to detail by a firm conviction of the importance of its bearing on the mooted question of cheap and effective illumination; and, moreover, actuated by the sense of satisfaction one feels, who, amid new reactions and unlooked-for results, can see old principles and laws working in harmony.

The points in the theory herein stated may be divided into two classes, those known and allowed for *before* practice, and those proven and exemplified *by* practice.

We wish here to disclaim the discovery or application of any new law in chemistry or physics, but to attribute our practical success to the fact that in that practice our endeavour was to comprehend the known laws which govern the various reactions, and to expose our material to their influence at the proper time and in the conditions best adapted to easy and successful working.

The power of a steam boiler is constant, but that is the best engine and he the best engineer who can account for the largest fraction of that power in actual useful work.

So we, taking the chemical fact that in a given weight of carbon and steam exists potentially a given amount of gas as a basis, aimed so to construct our machinery that the useless work should be reduced to a minimum, and to so handle it that the labour, oil, and fuel of each day, should be represented by the largest and best product which theory has proven to exist therein.

That we have fallen short of perfection is not strange, our greatest yield (400 cubic feet of gas to the gallon) looking small as compared with the 700 or 800 claimed by theory, yet it bears satisfactory comparison with the 120 or 125 feet of mixed gas and air which has represented a gallon of petroleum heretofore.

There remains now no question of fact. We know that we have produced gas in paying quantities in less time and with less labour and fuel than it can be made from coal, and that we have sent that gas through 56 miles of main into the houses of a city of 75,000 inhabitants, not one of whom was aware that it was other than coal gas, thus vindicating its claim to the title of "commercial illuminating gas."

The important mechanical problems have also received satisfactory solution, and to-day nothing remains but the adjustment of details and the acquiring that perfect familiarity with the process which comes with time and experience alone.

294, *Broadway, New York, U.S.A.*

REPORT OF THE SELECT COMMITTEE OF THE HOUSE OF COMMONS ON COAL.

The select committee appointed to inquire into the causes of the present dearness and scarcity of coal, and report thereon to the House, have considered the matters to them referred, and have agreed to the following report:—

The Royal Commission appointed in 1866 to investigate the probable quantity of coal contained in the coal-fields of the United Kingdom and the quantity of coal then consumed and exported, having presented, in July, 1871, a voluminous report on the subject, your committee have not deemed it expedient to inquire into any of the matters embraced in that report; but it may be convenient to refer to some of the conclusions at which the commission arrived to explain more fully the present condition of the coal supply which your committee were appointed to investigate.

It was ascertained by the most careful examination of the coal-fields of Great Britain, and the production of the mines at work in them, that there was an abundant supply of coal for the present as well as for the future for many years to come, but the possible failure of the supply at some distant period was the subject of much interesting speculation, which in the main appeared to depend on the estimate which might be formed of the growth of the population and the increase of consumption of the United Kingdom, and to some extent of other countries. Your committee deem it equally unnecessary and futile to embark in any such speculative conjectures, for they are of opinion that no adequate materials exist for giving any judgment on the subject, and that they consider they will best satisfy the object of their appointment by confining their report to a period immediately associated with the present condition of the coal supply.

The progressive increase of the population and of the supply and consumption of coal, as well as the computed rate of consumption per head of the population of Great Britain for the last 15 years, is shown by the following table taken from the reports of the Royal Coal Commission, 1869, corrected from the most recent returns. It has not been deemed necessary to include Ireland in the table, because the production of coal in Ireland is comparatively small, and the quantity of coal imported into Ireland is included in the quantity stated to have been exported from Great Britain. No account has been published of the quantity of coal exported to Ireland before 1867, but for the purpose of comparison it has been assumed at two millions for the previous years.

	Population.			Coal.					
Year.	Great Britain.	Increase.	Per Cent. Increase.	Raised.	Exported to Foreign Countries.	Exported to Ireland.	Retained for Home Consumption.	Increase or Decrease.	Total of Coal in relation to each Head of the Population.
				Tons.	Tons.	Tons.	Tons.	Tons.	T. cwt. qrs. lbs.
1858	22,498,956	..	..	64,587,899	6,597,128	2,000,000	55,990,771	..	2 9 3 24
1859	22,728,513	229,557	1·0	71,859,465	7,082,029	,,	62,777,436	6,786,665	2 15 1 0
1860	22,957,451	228,938	1·0	79,923,273	7,412,575	,,	70,510,698	7,733,262	3 1 1 20
1861	23,185,947	228,496	0·9	85,512,144	7,934,832	,,	75,577,312	5,066,614	3 5 1 0
1862	23,449,987	264,040	1·1	83,510,838	8,380,673	,,	72,130,165	3,447,147	3 1 2 0
1863	23,716,943	266,956	1·1	88,165,465	8,342,500	,,	77,822,965	5,692,800	3 5 2 13
1864	23,990,091	273,148	1·1	92,662,873	8,900,872	,,	81,762,001	3,939,036	3 8 0 19
1865	24,270,012	279,921	1·1	98,150,587	9,283,214	,,	86,867,373	5,105,372	3 11 2 10
1866	24,557,290	287,278	1·1	101,506,794	10,142,260	,,	89,364,534	2,497,161	3 12 3 0
1867	24,852,540	295,250	1·2	104,375,480	10,565,829	2,676,650	91,143,011	1,778,477	3 13 1 11
1868	25,156,419	303,879	1·2	103,014,207	10,967,062	2,216,899	89,830,246	1,312,765	3 11 1 11
1869	25,469,594	313,175	1·2	107,299,634	10,744,945	2,398,541	94,156,148	4,325,902	3 13 3 26
1870	25,792,784	323,190	1·2	110,289,732	11,702,649	2,568,271	96,018,802	1,862,654	3 14 1 23
1871	26,126,734	333,950	1·2	117,186,278	12,747,989	2,593,197	101,845,092	5,826,290	3 17 3 23
1872	26,472,225	345,491	1·3	123,386,758	13,211,961	2,611,911	107,562,886	5,717,794	4 1 1 1

A witness has, however, estimated the supply for the year 1872 at 120 million tons, and the evidence of other witnesses tends to confirm the general impression prevailing amongst the trade that the supply in the past year has not increased to the extent shown in the table. Though the table may be deemed sufficient for the purpose of a general comparison of one year with another, it cannot be accepted as more than an approximate estimate of the quantity actually raised and consumed in each year, it being subject to numerous imperfections and inaccuracies which there are no means of eliminating.

Nor does the table afford a correct view of the quantity of coal which the collieries at work might have produced for the purposes of sale, as, owing to the insufficient demand for some sorts of small coal until a recent period, a large quantity, which no one has been able to estimate, has been lost; besides this, owing to a variety of defects in the several systems of working, capable of remedy in varying degrees, it has been estimated by the Royal Commission that the quantity of coal actually produced for consumption out of a given area is less by 10 to 40 per cent. than the coal measured in the strata, involving a loss of coal to that extent. These per centages, if they could be saved for consumption, would entirely alter all the conclusions which might otherwise be drawn respecting the future from the quantities of coal mentioned in the table.

In order to ascertain the causes which have led to the apparent scarcity of coal at this time, your committee have inquired how far it arises from a diminution or stagnation of supply or from an unusual increase of demand for consumption, either temporary or permanent in its character, and the result of the information they have received may be briefly stated.

Your committee have examined some of the most experienced colliery proprietors and managers, whose evidence acquires additional weight from the fact that some were selected as representative witnesses by important bodies of colliery owners. They concur generally in opinion that there has been considerable disturbance in the minds of the workmen employed in and about the mines respecting the number of hours per day or per week during which the workmen deemed it to their interest to work in the mines, and that the general tendency has been to reduce the hours of labour. It has also been stated that the Mines Regulation Act, passed last session, has tended to the same result, and that the consequence of this has been the mines have not produced the quantity of coal which would otherwise have been obtained from them.

Your committee have no reason to doubt that one of the greatest benefits which can be conferred on the mining population is to induce them to work with regularity day by day, and for such a time daily as, while it will not deteriorate their health, social comfort, or moral condition, will not result in idleness or dissipation; but as no standard can be laid down to fulfil these conditions, it must be left to the general feeling of the workmen, improved by education, to arrive, in concert with their employers, at the proper limits for their labour. Your committee, however, are led to hope that when the employment of the men has adjusted itself to the requirements of the new law, and to their desire for improving their condition, the aggregate result of the labour of the mining population will not be less than in former times.

Your committee have endeavoured to ascertain the precise effect of the circumstances above noticed on the production of coal per man employed in the collieries. The following table shows the result of the returns made by the managers of all the collieries to the inspectors of mines on the subject.

Year.	Number of Men Employed.	Quantity of Coal Raised per Man. Tons.
1864	307,542	309
1865	315,451	313
1866	320,663	314
1867	333,116	316
1868	346,820	302
1869	345,446	316
1870	350,894	321
1871	370,881	317
1872	413,334	299

But the comparison between 1872 and the former years is affected by the facts that the previous returns were not compulsory, and did not include in all cases the whole of the persons employed in the mine and about the colliery, nor do the returns admit of any account being taken of the saving of labour, either in the mine or above ground, in consequence of improved arrangements for working the collieries, or delivering the coal into the waggons for transport.

The evidence given in some individual cases shows that the quantity raised per man has diminished in the last year, and, on the whole, your committee think that the diminution in the yield per man employed in getting coal in the mine since 1871 is not much less than that shown in the table.

There is no doubt of the capacity of existing collieries to keep up the present supply of coal, and that with an adequate provision of suitable labour the supply could be largely increased; but a period of time extending over several months is requisite to open out or extend new workings and to qualify workmen who have been otherwise engaged for the special employment in the collieries. Your committee have received sufficient evidence to show that these operations are now going on, stimulated by the present high prices, and they see no reason to doubt that, in a short time, the collieries now existing, and others likely to be opened, will be capable of producing a large increase of marketable coal. Your committee would call particular attention to the following evidence given in answer to question 7542, showing that the double-shift system in working the collieries tends both to increased facility and greater economy in production:—"The bulk of the coal will hereafter be raised from deep collieries, and, so far as these are concerned, more time will be required. There will have to be some arrangement about working, by which, instead of something like 40 to 50 hours a week (because that is all they do now work in coal drawing), some double shift, or something which will enable the person who invests his large capital in these undertakings to get a larger quantity out than can possibly be raised in that short time. If that is not done, there will be a much larger price paid, and that must be paid, of course, by the consumer in the end. But if that arrangement can be effected, I believe that instead of the price being increased by such a system, economy may be effected under that arrangement. And I should not look forward to imposing longer hours upon the boys; in fact, I think they might be shortened; and I should for myself, as a deep colliery worker, be disposed to compromise the question, to give them the same

wages for less time than that for which I now pay them, provided I could have a succession of labour, so as to make 16 or 17 hours in the day instead of eight or nine, or 10, as the matter stands. I will give you a practical illustration of that. I am intimately acquainted with two collieries, one of which is in Glamorganshire, and the other in Durham. Both collieries have cost more than £250,000, therefore they are large ones. In the Durham one they are raising nearly twice the quantity per day that they are getting out of the other; and in the Glamorganshire colliery there is twice the amount by the system of working the face opened out for the 1000 tons that there is in Durham for the 2000 tons; because that is something like the quantity, 1000 tons a day at one, and nearly 2000 at the other. Now I hope that that condition of things will be fairly met by the workmen. It will be necessary that it should be done, and I rather look (and I do not say this in flattering terms) to the influence of men like Mr. M'Donald, and those who are the representatives of the men, in overcoming the prejudice—because it is a very strong prejudice in South Wales—against this system; and I look for their co-operation in assisting us to get the system of working there put upon a sounder and a safer footing than it now is." It appears that the subject is now being much discussed by employers and workmen for the purpose of extending the double-shift system to collieries in districts where it has never been introduced, and your committee hope that, when the advantages of the system have been fully understood amongst the workmen, it may be more extensively employed, under conditions which may be satisfactory to the colliery owners and their workmen.

In the course of the inquiry evidence has been received respecting several matters which exercise an influence over the general result of coal mining operations, such as the difficulty of obtaining residences for workmen on any sudden expansion of the number employed; the difficulty of draining mines when the workings of different proprietors adjoin each other, and are affected by the same influx of water; the difficulty of obtaining increased means of transport in case of any sudden increase in the demand for it; and the difficulty of making arrangements by arbitration, mediation, or otherwise, between large bodies of workmen and of employers, when, in consequence of the extensive scale on which their industry is organized, it becomes necessary for all to work according to some common basis or organization. Your committee have not deemed it necessary to pursue their inquiry into all these and other subjects of a similar character, but of less importance, for the purpose of arriving at a deliberate opinion on them, but they refer to the evidence they have incidentally received.

The general conclusion to be drawn from the whole evidence is, that though the production of coal increased in 1872 in a smaller ratio than it had increased in the years immediately preceding, yet if an adequate supply of labour can be obtained the increase of production will shortly keep pace with that of the last few years.

With regard to the Consumption of Coal.

It was estimated by the Royal Commission, upon returns received in reply to circulars issued, and upon the statistics collected by the Mining Record Office, that the coal raised in the year 1869 had been consumed in the manner shown in the following table, which Mr. Robert Hunt, the official keeper of the mining records, has continued by estimate from the data obtained in 1869, and from the mineral statistics of the office for the years 1870 and 1871.

	1869.		1870.		1871.	
	Make of Metals, &c.	Consumption and Exportation.	Make of Metals, &c.	Consumption and Exportation.	Make of Metals, &c.	Consumption and Exportation.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Pig iron	5,445,757	16,337,271	5,963,515	17,890,545	6,627,179	19,881,537
Bar iron and steel	4,734,145	16,109,335	...	17,489,794	5,566,175	18,648,686
Tin	9,356	22,679	10,200	24,480	11,320	27,168
Copper, British	8,291	460,083	7,175	427,500	6,281	376,412
Copper ore, imported	34,971		27,163		63,673	
Lead, British	73,529	145,299	73,420	150,038	69,056	157,353
Lead ore, imported	11,874		12,316		20,860	
Zinc, British	4,500	231,170	3,936	242,445	4,966	171,920
Zinc ore, imported	41,736		44,553		29,418	
	Number.		Number.			
Collieries	2,852	6,714,222	2,851	6,713,210	2,816	6,578,800
Metal mines	740	511,201	738	508,222	768	529,920
Manufactures, for steam and other purposes		25,327,213				
Steam navigation*		3,277,562				
Railways, locomotives, and other purposes		2,027,500				
Army departments		195,000	...	+ 37,100,000	...	+ 39,000,000
Gas-making		6,311,980				
Water-works and miscellaneous		1,500,000				
Total of coal used in all manufactures, and for steam		79,170,515	...	80,546,234	...	85,371,796
Exports‡		§ 10,744,945	...	11,744,945	...	12,747,989
Domestic use, &c.		15,113,556	...	15,571,742	...	16,639,046
Exported to Ireland		2,398,541	...	2,568,271	...	2,593,197
Total production of coal		107,427,557	...	110,431,198	...	117,352,028

* This includes the steam navy and naval departments.
‡ Including coke and patent fuel
+ Estimated on the basis of the returns for 1869, and general knowledge.
§ Corrected from parliamentary return. Coal Commission report gives 9,775,470.

The foregoing table includes the consumption by the people of Great Britain for their own use, and for the whole of their manufactures exported to Ireland and to foreign countries; but a more exact idea of domestic consumption may be obtained from the accounts of the importation of coal into the London district, which are kept for the collection of the coal tax, and show the quantity of coal used for house and other purposes, for the most part of a local character, as exhibited in the following table:—

	Population, Metropolitan District.	Quantity of Coal brought into the London Market.		Total brought into London District.	Quantity Exported or Conveyed beyond the London District.	Total Quantity left for Consumption in London District.	Total Quantity estimated to be used in Brickmaking, Gas, Water-Works, and General Manufactures.	Remaining for Domestic Consumption, Railways, and Steamboats in London.	Consumption per Head of Population of Entire Quantity in London District.
		By Rail and Canal.	By Sea.						
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tns. cwt. qrs. lbs.
1869	3,760,501	3,348,527	2,873,688	6,222,215	1,088,548	5,133,667	2,965,192	2,168,475	1 7 1 7
1870	3,831,508	3,765,391	2,993,710	6,759,101	1,179,430	5,579,671	3,054,798	2,524,873	1 9 0 0
1871	3,903,855	4,449,141	2,762,712	7,211,853	1,401,064	5,810,789	3,230,757	2,580,032	1 9 3 0
1872	3,977,569	5,007,505	2,548,918	7,556,423	1,655,733	5,900,690	3,365,090	2,535,090	1 9 2 0

It is apparent from the table that the ratio of increased supply was not maintained in 1872, and Mr. Cory, a witness of great means of information, stated in his evidence that in the five months of the present year, as compared with the five months of the year immediately preceding, the deficiency of supply might be estimated at 185,000 tons for the London district.

With regard to the probable effect of consumption in relation to the supply of coal for various branches of industry, the Royal Commission justly considered that it was important to ascertain how far coal was wasted by carelessness, or neglect of proper appliances for its economical consumption. They reported the result of the labours of the committee appointed by them to inquire into the subject, as follows:—"The conclusion arrived at by this committee was, that 'for some time past in our manufactures there have been constant and persevering efforts to economize coal by the application of improved appliances for its consumption.' The committee had reason to believe that 'in some branches of manufacture the limits of a beneficial economy appeared to have been nearly reached, and that in other cases a gradual effort would continue to be made for saving fuel.' It may be assumed, therefore, that the progress of economy in using coal is not likely to operate in future with greater effect in keeping down the increase of consumption than it has hitherto done." This conclusion must now be qualified by the fact that the increased value of the commodity renders any saving of much greater importance than it was in former times, and it is therefore probable that the increase of consumption of coal will be diminished by greater economy in its use.

The commissioners further report that "the present consumption of coal for domestic use is generally estimated at 1 ton per head of the whole population, and may be assumed to absorb one-third of the entire production. It is probable that this rate per head will continue pretty constant, because, although more economical methods of using coal in dwellings may probably be introduced, yet the increasing wealth of the nation will cause coal to be more liberally used for domestic purposes. The future increase of consumption under this head may, therefore, be expected to coincide with the increase of population." It is, however, apparent from the foregoing tables that, apart from domestic consumption in the mining districts when coal was sold at a very low rate, and used plentifully, if not wastefully, the consumption for purely household purposes is much less per head, and absorbed much less, in proportion to the entire production.

The Royal Commission also inquired into the probable increase of the export of coal, and arrived at the following results:—"As regards the future exportation of coal, although a very large increase has taken place within the period embraced by the preceding table (printed in the appendix), yet there is reason to doubt whether much further increase will take place in this direction. Upon this point Committee E have reported that the probable development of the enormous coal-fields of North America, and those of India, China, Japan, and other countries, and the more effective working of the known coal-fields of Europe, will probably prevent any considerable increase in the future exportation of British coal." This opinion may be qualified by the table of subsequent exports already quoted, to which may be added the export of 6,018,910 tons in the past six months of the present year, as compared with 6,446,080 tons during the same period of last year; but your committee are of opinion that it cannot be assumed that further increase of exportation will not take place.

The foregoing considerations would not account for the present condition of the coal trade. Your committee have therefore endeavoured to ascertain how far the demand for coal for any special branches of industry has been affected since the report of the Royal Commission. They have found a very general concurrence of opinion amongst the witnesses they have examined, that the flourishing condition of the industry of the country and of the population has fully sustained and even enhanced the rate of increase of consumption for the purposes of industry in general as well as for domestic use. There is also an equal agreement amongst the witnesses that the special branch of manufacture which has extended the demand for coal to a degree which could not be met by the producers, and which led to the rise in the price of coal, was the manufacture of pig iron and its conversion into the various forms of rolled iron, and that this increase of demand mainly came from the United States of America and from Germany. The exceptional condition of both these coun-

tries need not be expatiated upon to explain how the demand from them first arose. The condition of the iron manufactures and the consumption of coal in carrying them on for the last six years will be better appreciated from the following summary:—

	Pig Iron Produced.	Pig Iron Exported.	Pig Iron left for Conversion into Rolled Iron.	Rolled Iron Exported.	Coal used in the Manufacture of Pig Iron at 3 Tons to the Ton of Pig Iron.	Coal required to convert the Pig into Rolled Iron, &c., at 5 Tons 7 Cwt. to the Ton of Bar Iron.	Total Coal used in Iron Manufacture.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1867	4,761,023	567,319	4,193,704	1,317,038	14,283,069	14,048,908	28,331,977
1868	4,970,206	555,020	4,415,186	1,480,138	14,910,618	14,790,873	29,701,491
1869	5,445,757	711,612	4,734,145	1,970,067	16,337,271	15,859,335	32,196,606
1870	5,963,515	753,339	5,210,176	2,072,236	17,890,545	17,454,098	35,344,634
1871	6,627,179	1,057,458	5,569,721	2,111,761	19,881,537	18,658,565	38,540,102
1872	6,723,387	1,332,726	5,390,661	2,055,896	20,170,161	18,058,714	38,228,875

The exact effect of the iron manufacture and trade on the coal market is best shown by the evidence of Mr. Isaac Lowthian Bell, largely connected with iron-works on the Wear, the Tyne, and the Tees, who thus describes the rise in the price of pig iron, and the consequent rise in the price of coal:—"You come to the conclusion that the source of the whole disturbance was in the great increased demand for pig iron, and maleable iron, and manufactured iron?—I do not say the sole cause; it was one of the causes. Of course, a coal-field which had no iron-field would not have been affected by it; but we know a greatly increased demand has been felt everywhere. With us, no doubt, the iron trade gave a great stimulus to the coal trade, and I think the coke in our neighbourhood in consequence rose much higher than the coke in any other district. But the fact is, all industry all through the country has been, and still is, I may say, in a very flourishing condition, and the iron trade with others. The manufacture of alkali in the north of England is in a very flourishing condition; and again, the increase of railways, and the general substitution of steam for sailing vessels, all added to demands on an output not very greatly increasing, have, I conceive, led to the present state of things." Then, in your view, it seems that the iron trade primarily, and other trades in a less degree, caused an increase of demand with greater rapidity than the production of the coal?—Certainly, in the north of England it was so. In September, 1871, forge pig iron was selling with us for 50s., and coke was selling at from 10s. to 12s. a ton; pig iron rose gradually towards the end of the year to 64s., but coke was not affected up to that time. In January, pig iron rose from 64s. to 70s. 6d., and coke rose to 20s. In March, forge pig iron was 84s., and coke was 25s. In April, the pig iron rose to 94s., and the coke rose to 32s. 6d. In July, the forge pig iron rose to 110s.; more than twice what it was in 1870, nine months before; and the coke rose to 37s. 6d. and 41s. per ton. Now pig iron rose in spite of the increase in the quantity made; that is, there were more blast-furnaces built and at work in July, 1872, than there were in 1871, and yet pig iron rose unexpectedly to us just as the coal had done to the coalowners. I believe there was not a single house in Middlesborough that had not six months orders on hand at 45s. to 47s. a ton, when pig iron was selling at nearly 120s.; but as it was up to 120s., they were too glad to give even 41s. a ton for the coke, in order to profit by the increase in the price of iron."

In the ordinary course of trade, the fluctuation in the price of coal might have been limited to the particular quality used specially in the manufacture of iron. The demand, however, was apparently so urgent, that it soon extended itself to other qualities, and exercised an influence over their price. The prosperous state of several branches of industry produced a competition for coal which obliged all classes to pay the high price demanded, rather than suffer the loss consequent upon a diminution of business, or the discomfort arising from want of coal for domestic use. The production and export of iron, and the production and consumption of coal, shown in the tables above quoted, might not be deemed sufficient to account for the great rise in the prices of those commodities, but the exact effect of any disturbance of the relations of demand and supply on prices is beyond the limit of arithmetical calculation. Price depends not merely on the quantity of the commodity, but on the motives with influence both the buyer and the seller in determining how much the one is content to receive, and how much the other is willing and able to pay, under the belief that the quantity brought to market is or may be insufficient to meet the demand. In the case of coal much of the demand is of such an urgent nature that the buyer would pay a very large price rather than be deprived of the supply he requires. Nor does the ratio of increase of price necessarily bear any definite proportion to the ratio of diminution of supply. A comparatively small deficiency may produce a very large increase of price if the eagerness of each buyer to secure his own supply, and to guard against deficiency in his own case, is coupled with the ability to pay for it whatever is demanded by the seller. This appears to have been the result of the comparatively small derangement in the production and consumption of coal, enhancing its price in so great a degree.

In London, as the largest example of the effect of the disturbance in the coal trade for domestic purposes, it appears from the evidence of an extensive coal merchant that the average prices at the present time, compared with preceding years, for the best house coal, taken as a standard, are as follows:—

1868	18s. 7d.	1871	19s. 3d.
1869	18s. 8d.	1872	24s. 11d.
1870	18s. 6d.	1873, for 5 months	32s. 6d.

but it is to be observed that these are the prices of coal bought in ship loads and delivered into a barge, or on a wharf, over the ship's side, the coal-tax being borne by the seller, and that the actual price to the consumer of coal delivered on his premises is generally taken in the trade to be about five or six shillings above the wholesale market rate when it was low, and six or seven shillings now that it is high to cover all the intermediate charges and losses. The supply of coal to London by railway is subject to various conditions affecting both qualities and prices which do not admit of the same general classification.

The coal trade has been no exception to the violent fluctuations which arise when the ordinary course of business is disturbed on account of unusually high prices, by panic demands for the moment, and speculations for the rise or fall. These have raised or depressed the average prices above quoted for short periods. In London, the price on the Coal Exchange reached 45s. for two days in February last. For further information on this subject your committee can only refer to the evidence they have taken.

Your committee see no reason whatever to believe that any effort has been made by the colliery owners to restrict the supply of coal for the purpose of creating, by such artificial means, a scarcity in the market; on the contrary, means appear to have been taken by them to meet the extra demand. The supply has been, indeed, somewhat augmented by the remarkable manner in which the small coal, formerly of no account, has now been brought to market and sold at a considerable price, to be used instead of other qualities of coal. The large stocks which were kept in some districts have also been brought to market in the last year, in addition to the current supply.

Your committee notice with regret that some efforts have been made amongst the workmen to induce them to take active means to prevent the colliery owners from increasing the output of coal, under an impression that they can thereby create a scarcity, and maintain a high rate of wages; also that the like efforts have been made to prevent the colliery owners from having stocks of coal at bank ready for use, under the impression that it would confer upon the employers greater power to reduce their workmen's wages. Considering the practice which has grown up in the coal trade, and in many branches of industry dependent on coal, of making contracts for delivery over extended periods of time, which in many cases has become a necessity, and that there are at the same time sudden demands for considerable quantities of coal, your committee believe that any attempt to prevent the supply of coal, or the accumulation of such stocks, as those who are responsible for carrying on the trade deem necessary, is as injurious to the interest of the general public as of the workmen in the mines. The deterioration of coal from exposure on the bank, and the loss of its value and cost, entail such a sacrifice on the colliery owner that he is not likely to keep a greater stock than the exigencies of his business require. It is of the greatest importance to the welfare of the men that every facility should be afforded to the employers to keep them in regular work by equalizing the production of one period with another, which can only be accomplished by accumulating a stock when there is a temporary slackness of demand. It is, however, just to observe that the views of the workmen above noticed have been disclaimed by some of the witnesses who have appeared before your committee for the express purpose of representing the views of large bodies of miners.

Considering the great extent of the coal-fields in Great Britain, the number of collieries at work, and the variety of coals produced, which, though primarily used for particular purposes, will, at certain prices, be used for others, your committee, notwithstanding intermittent and startling fluctuations in price due to temporary causes, do not believe that any combination either of employers or workmen can by artificial means succeed in permanently affecting the ordinary results of the relations of demand and supply in adjusting the quantity of coal produced to the demand, or can permanently affect the price resulting from the state of the market; nor do your committee believe that the interference of Parliament with the course of industry and trade in coal could produce any useful or beneficial result to the public beyond what has been arrived at in recent legislation—namely, the prevention of injury to the health and morals of children and young persons, and the prevention of accidents from wilful neglect of recognized precautions.

It has, however, been suggested that there is a distinction between permitting the free use of coal in the United Kingdom and its free exportation to foreign states, and that the latter should be restrained or obstructed by an export duty. But without entering into the subject at large, your committee may point out that there are special objections to an export duty on coal beyond those of the general policy of the country, which would not apply with the same force to many other commodities.

The coal exported to foreign parts is not for the exclusive use of foreign countries. A considerable quantity is used by English shipowners for their homeward and other voyages, while foreign steamships load coal at English ports for their own consumption. It would be as injurious to the English shipowner, and to the merchant whose goods he carries, and to the workman who made them, to deny them the free use of English coal, as it would be impracticable to levy a differential duty on coal consumed in foreign ships trading with England. Even when the coal is consumed in the interior of foreign countries, it is not unfrequently used on their railways to bring to their ports commodities to be imported into this country, whether raw or manufactured, to be exchanged for the exports from England, and all these operations would be prejudiced to the extent to which English coal abroad would either be enhanced in price or diminished in supply.

Nor would any duty which could have been placed on coal have had a material effect in mitigating the demand for coal, and the consequent rise in prices at the present time, as it appears that the excess of demand for export was not for coal, but for iron, and every ton of pig iron exported was in effect an export of two or three tons of coal, and of rolled iron of about six tons of coal. The manufacture of iron in a more advanced stage, and of many other commodities, requires a large consumption of coal; the increased export of those articles would also be in effect an increased export of coal, and if the result of an export duty on the coal itself deprived foreign countries of the means of manufacturing commodities in which coal is used, it would only have the effect of increasing the export of those commodities, and consequently of the consumption in England of the coal required for their production, unless there resulted a general diminution of industry and trade, and a cheapening of coal by depriving the people both of their power to use it in manufacture and to purchase it for domestic use.

Your committee, however, have been informed by a witness with considerable opportunity of forming his opinion, that the high price to which iron rose had the effect of checking the demand from foreign countries; and several of the witnesses are of opinion that the higher prices are tending to bring about such an equilibrium of supply and demand as will not only prevent any continued rise in price, but will in a short time reduce the price. Your committee are satisfied that the prices of coal which prevailed for several years before the present rise commenced were so low that they did not afford a reasonable profit to the owners of collieries in general, nor such remuneration as the workmen might, with regard to the hazardous and arduous nature of their labour, reasonably expect.

Much evidence has, however, been given to show the great increase in the rate of wages, and the earnings of the working miners; but whilst it is true that in some cases the earnings have enormously increased, and have been improvidently spent, your committee conclude that in general the condition of the workmen has been much improved, and that the rise in the rate of wages has not, under the exceptional circumstances, been unreasonable, nor been unattended with considerable benefit to the workmen; indeed, in some cases the workmen have preferred improving the conditions under which they work to increasing the amount of their wages in money.

It is clearly shown that the real order of events has been the rise in the price of iron, the rise in the price of coal, and the rise in the rate of wages. The increased payment per ton for labour employed in getting the coal cannot therefore be considered as the primary cause of the large increase in the price of coal; a rise in wages followed upon, rather than preceded a rise in the price of coal. To the extent to which increased rates of wages have induced workmen to labour for a shorter number of hours than heretofore, resulting in a reduced output per man, a higher payment for labour has contributed indirectly in an important degree to maintain the high price of coal; but having regard to the great danger to which coal miners are exposed, and the character of their labour, the average rate of wages in collieries has not been more than sufficient to attract the requisite labour to the mine. The workmen, like all others connected with coal mining, should only regard their present earn-

ings as a temporary profit, which may, at no distant day, approach towards former rates.

Your committee have not entered into an examination of the profits of colliery proprietors since the rise in prices. In the case of a joint-stock company, its accounts were produced, showing its profits to have been unusually high, but in many cases the proprietors were under the obligation of running contracts for various periods of time, entered into at the low rates previously prevailing; and the actual net profits of a colliery depend on so many circumstances affecting capital, materials, labour, proximity of consumption, facility of transport, and regularity of sale, that they could not be arrived at without a careful inquiry into the accounts of each separate undertaking.

Nor would your committee have been justified in embarking in any such inquiry, for in all the enterprises and trades of the country, long experience shews that high prices, with exceptional profits, arise occasionally in each. They believe that the true policy of the country and the best inducement to the proper conduct of business, as well as the greatest stimulus to a return to a more just balance between supply and demand is to leave the trade free, and to maintain an inflexible resolution of non-interference on the part of the State. To adopt the opposite course would be to make one class pay for the benefit of another, whilst any restraint on the profits of private business or industry by the power of the law, must, in justice, carry with it the guarantee of the resources of the State against loss, which, in the opinion of your committee, is altogether impolitic.

July 18, 1873.

METROPOLIS WATER SUPPLY.

Major Bolton's report on the water supplied to the metropolis in June states that during the whole of the month the state of the river at Hampton, Molesey, and Sunbury, where the intakes of the West Middlesex, Grand Junction, Southwark and Vauxhall, Lambeth, and East London Companies are situated, was good The highest flood state of the river at Hampton during the month was 7 inches above the (6 feet) summer level.

At Ditton (where the Chelsea Company now alone draws its supply) the state of the water in the river was good during the month. The highest state of the flood water at this place was 8 inches, and the lowest 2 inches, above summer level. The highest temperature of the water during the month was 68°, and the lowest 59°, while the highest temperature of the air at the same place was 79°, and the lowest 51°. These observations were made daily at 9 a.m. The rainfall during the month was 2·09 inches.

The Grand Junction Company have completed a high service reservoir near Kilburn, to contain 6 million gallons for constant supply, and are now laying a line of main pipes to connect up this reservoir with the works at Campden Hill.

The Lambeth Company are actively carrying out extensions and improvements in their works. At Molesey, the construction of reservoirs is being proceeded with to contain 110 million to 120 million gallons of water, with pumping-engines to fill them to a level of 12 feet above the river. When full they will contain 10 to 12 days winter supply to the district, and during the months when floods prevail (by selecting the times of pumping when the river water is in the best condition) a good deal of flood water will be allowed to pass. Several days subsidence will thus be provided, and consequently an improvement in the water may be anticipated. The water from the reservoirs will run by gravitation through the new conduit to the filters at Ditton, which are in course of extension by the conversion of the two reservoirs there into filter-beds, which, when finished, will increase the present filtering surface by 70 per cent.

This company has also just completed and taken into regular use a new covered reservoir at Streatham, to contain 3,750,000 gallons of filtered water, and the old reservoir is for the time abandoned, and has been ordered to be covered.

Influence of Coal Gas on the Growth of Trees.—The "Annals of Agriculture" (Berlin), 1872, contains an account of some experiments made in the Botanical Garden, Berlin, to ascertain the influence of coal gas on the life of trees. A maple and a lime tree, each of considerable size, were selected for the experiments, which were made by carrying a pipe, at a depth in the soil of 2½ feet, to within 3 or 4 feet of the trees, and allowing 100 cubic feet to escape daily for six months. This treatment was begun in July, and after a month the trees began to look sickly. The maple died in the following spring, and the lime in the summer. An examination showed that, as might have been expected, the poisoning began at the growing extremities of the roots, the spongiolæ, and the trees probably died for want of nutrition. To ascertain what might be the effect of something more like ordinary leakage another experiment was made, and 25 feet of gas were passed daily, about 4 feet below the surface, into a piece of ground having an area of 144 square feet, on which 12 young trees had been growing for a year and a half. In a week the trees showed signs of poisoning where the ground had been stamped down to prevent the escape of gas, and in a month all had lost their leaves.

Arbroath Gas Commission.—At the meeting of this corporation on the 14th inst., there was submitted an abstract of the accounts for the year, showing, as before reported, a balance in favour of the corporation of £19 2s. 3d., one-half of which is payable to the magistrates and council for public improvements, and the other to the gas consumers as discount. The revenue from consumers was £7777 15s. 4d., less discount of 5d. per 1000 feet, £522 3s. 8d.—£7255 11s. 8d. The provost explained that material had cost £1286 more than last year; retorts, ascension-pipes, &c., £181 more. The new meters had cost £60 more. The consumers now number 4910, being an increase of 118. The revenue from gas showed an increase of £421, and on tar of £24. The coals had cost on an average 25s. 11½d. In Dundee, he observed, they had cost 25s. 11d. Coals, as they all knew, had risen greatly in price. The balance they had last year was £4200 4s. 1d. There had been expended on the new coal-shed and steam-pump £1117 18s. 4d. £922 11s. 3d. of the accounts were at the date of the audit outstanding, being something less than last year. The whole of the outlay on retorts, &c., had been charged to revenue, whereas they should have been placed to capital. They had been put to revenue because next year the corporation would have to set aside £200 as a sinking-fund. The price of gas would this year be fixed, in terms of the statute, at 5s. 10d. Mr. Dickson remarked that had the gas-works been in the hands of a private company the result of this year's working would have been an increase in the price of gas. Their not having this year the advantages of the cheap coal in stock, which they had last year, the chances were that the next balance-sheet would not be so favourable. On the motion of Bailie Salmond, the thanks of the corporation were awarded to the managing committee, and to Mr. Brown, the manager, which concluded the meeting.

Gas Explosion at Worcester.—An explosion of gas occurred at the City and County Bank, in this city, on Tuesday, the 22nd inst. It appears that one of the clerks entered the large iron safe at the rear of the banking office, at a little before nine o'clock in the morning, and immediately perceived a smell of gas; but, not deeming the matter of much importance, he incautiously lit a match for the purpose of lighting the gas-jet, and thus enabling him to detect where the escape arose. He had no sooner struck the match, however, than an explosion took place. The clerk was blown for some distance; his face and hands were scorched, and his hair singed, besides which he was, of course, greatly stunned. He was at once removed to the Infirmary. The safe being composed of iron of the most massive character, built round with strong fire-brick walls, the explosion had scarcely any effect upon it, consequently the whole force of the explosion came through the open door of the safe, from whence the unfortunate clerk must have been blown. Two windows in the swing doors leading into the bank, one in Mr. Abell's office, one in the waiting-room, and one in the bank itself, all composed of thick plate glass, were shattered to attoms. Several of the doors were burst open, and the main entrance doors, which are made of iron, were bulged out. Fortunately the shutters of the bank had been wound down ready for commencing the day's business, or a greater amount of damage must have resulted. Beyond what is stated above, no injury was sustained by the building itself. The damage is estimated at between £50 and £60. The building is insured. It is supposed that the gas in the bank safe had not been properly turned off on Monday evening, and the gas had thus accumulated during the night to a great extent. The injured clerk is progressing very favourably. No deeds or valuables of any kind were destroyed; several were injured, but not materially.

Holmfirth Gaslight Company.—A special general meeting of shareholders was held on the 5th inst., to consider the expediency of authorizing the directors to apply to Parliament for power to increase the capital, and for such other powers as might be deemed advantageous to the company. Mr. John Hixon presided as chairman, and there was a good attendance of shareholders. The clerk laid before the meeting an account of the condition of the company, and of the extensions required to meet the wants of the district; after which a resolution was moved by Mr. S. Robinson, of Bradford, and seconded by Mr. Dutton Hobson, of Netherthong, to the effect that the company make no application to Parliament at present, but that the directors be authorized to apply the profits made by them in payment of the debts of the company, and in extension of the works of the company, as the directors might think proper. This proposal would have the effect of paying off the debts instead of paying any dividends to the shareholders. An amendment was proposed by Mr. J. Tyas, and seconded by Mr. Jonathan Hirst, that in consequence of the increased consumption of gas in the district comprised within the limits of the Act of Parliament, and the present state of the works being inadequate to meet the requirements of the consumers of gas, and the company having expended the amount of the capital stock of £12,000 authorized by the Act of Parliament to be raised by shares, and also the sum of £4000 authorized by the Act to be borrowed on mortgage in establishing and carrying on the undertaking—that, for the purpose of empowering the directors to extend or enlarge the works to enable them to provide a sufficient supply of gas, application be made to Parliament for an Act to authorize the company to increase the capital or joint stock of the company by issuing new shares of £20 each, and also for power to borrow or raise by mortgage of the works or undertaking of the company further sums for the purposes of the Act; also that power be sought by the intended Act to capitalize the money to which the shareholders were entitled as interest, but which had been necessarily expended in the works of the company, and that the directors have full discretion to act as they think best in the matter. On the question being put to the meeting, there were 41 votes for the first motion, and 49 for the amendment, which was therefore carried.

Edinburgh.—Future Water Supply.—The question of an additional water supply for this city was taken up at a meeting of the Water Trust, held on the 17th inst. After considerable discussion, it was resolved to memorialize the Town Councils of Edinburgh, Leith, and Portobello, subject to the approval of the ratepayers, to prepare a bill to bring in an additional supply—with reference to which the trustees directed attention to the Lyne scheme, and to one reservoir in Glencorse; to take additional powers to check waste; and to effect an arrangement of the expenses incurred by the promoters of the St. Mary's Loch Bill, &c.

Southampton Public Lighting.—At the meeting of the Town Council of Southampton, on the 16th inst., the Special and General Works Committee reported that they had resolved to recommend the sanitary authority that the gas for the public lamps should be supplied by meter for one year from the 24th of June, 1873, and that Mr. Lemon, the surveyor, should see the directors of the gas company thereon. At a subsequent meeting a letter was submitted from Mr. C. C. Smith, secretary to the gas company, stating that the directors were glad to find it was intended to recommend the sanitary authority to adopt the system of paying for the gas consumed in the public lamps by the average meter system, in accordance with the terms and conditions of the Southampton Gas Act, 1865; and as the meters could not be fixed under three months, they were prepared to offer to light the lamps as at present, for the quarter ending Michaelmas next, at £4 7s. 6d. per lamp per annum. Further, having consulted with Mr. Lemon respecting the details of the average meter system, they were willing to enter upon the same under the following conditions:—1. The directors to make the experiment for one year of having only one meter fixed to every fifteen lamps within the borough, instead of one meter to every ten lamps, as set forth in their Act of Parliament, this concession being made without prejudice to the rights of the company given in the Act. 2. The company were willing to light and extinguish the lamps, and keep the same in good repair, for 16s. 6d. per lamp per annum, the cost of repairs to the catoptric lamps to be paid for by the corporation. 3. The company were willing to provide and fix complete the meters for the public lamps at £7 3s. 9d. per meter, exclusive of the pavior's work, which could be done by the corporation. At the same meeting, Mr. Lemon submitted a report of his interview with the directors, in which he stated that if their proposition were accepted, 54 meters would be required, which, at £7 3s. 9d. each, would cost £388 2s. 6d.; also that 16s. 6d. per lamp per annum for lighting, extinguishing, and repairing, would be rather above the average of other towns, and that the cost under the meter system would be for 4 cubic feet per hour per lamp, and to burn nine hours per night, at 4s. 6d. per 1000, £3 15s. 8d. per lamp per annum; and, in conclusion, he suggested that the police should keep a record of the time of lighting and extinguishing the lamps, and report the same to Mr. Breary every morning. He also recommended the committee to check in some measure the enormous consumption of gas in the street lamps by extinguishing those in the suburban districts during three months in the summer. The committee recommended the sanitary authority to agree to conditions 1 and 2, as contained in Mr. Smith's letter, and that condition 3 be referred to Mr. Lemon for further consideration, and to report thereon. The town-clerk said he had since received Mr. Lemon's report. He stated that the cost of the meter delivered in Southampton would be £6 7s. 9d., so that the charge made by the gas company for fixing and all connexions was 16s. per meter, which he did not think excessive. He, therefore, recommended the committee to adopt the wet meter mentioned for the street lamps, and to accept the offer of the gas company—viz., £7 1s. 9d. for each meter fixed completely. Mr. Chipperfield moved the adoption of the report. He said the committee had come to the conclusion that by exercising economy during the summer months of the year they might save the town expense. It was an experiment, but he hoped they would thus be able to pay the increase in cost of gas. Mr. Bailey seconded the motion. Mr. Le Feuvre suggested another mode of economy, by not lighting the lamps at all three or four days before and after full moon. They would thus save 13 weeks out of the 52, and reduce the consumption of gas for the lamps 25 per cent. Mr. Lemon said that by burning the gas nine hours per night at the rate of 4 feet per hour, they would save 10s. per lamp. Alderman Furber thought one-half of the gas was burned to waste, and if they could get the gas-works into their own hands and burn no more than they wanted they might save a large amount. Mr. Lemon showed that by the proposed system Alderman Furber's suggestion could be carried out. Mr. Chipperfield said they were going to burn by meter, but the gas company would light and extinguish the lamps. It would be a question afterwards whether the corporation would not undertake the task themselves, and then the police might do the work on their beats.

Price Current.

CASTINGS.—*Per Ton.*

Average Weight of Cast-iron Gas-pipes, per Yard.

1 in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lbs.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow.	Newcastle and Middlesboro'.	Wales.	Yorkshire, Derbyshire, and Staffordsh.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Pig Iron, No. 1 (g.m.b.)	—	5 7 0	6 7 6	6 10 0	6 5 0
1½ and 2 inch Socket-pipes	11 0 0	10 10 0	10 10 0	10 10 0	10 10 0
2½ and 3 inch do.	10 10 0	9 15 0	9 10 0	9 15 0	9 15 0
4 and 5 inch do.	10 0 0	9 10 0	9 0 0	9 10 0	9 10 0
6 inches and upwards, do.	9 10 0	9 0 0	8 17 6	9 0 0	9 0 0
Retorts, 1st fusion, hot blast	10 10 0	9 15 0	10 15 0	9 15 0	9 15 0
Do., 2nd do., cold do.	—	—	—	—	—
Tank Plates, ⅛ thick and above	11 10 0	15 0 0	11 0 0	11 0 0	16 0 0

WROUGHT-IRON TUBES AND FITTINGS.

(Subject to 25 per cent. discount.)

Internal Diameter in Inches.	2	1½	1¼	1	¾	½
TUBES.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Assorted, 2 to 14 feet, per foot	1 6	1 2	0 11	0 8	0 6	0 4½
Pieces, 12 to 23¼ inches, each	3 6	2 0	1 8	1 4	1 0	0 9
Do., 3 to 11¼ do.	2 3	1 4	1 1	0 11	0 8	0 6
Longscrews, 12 to 23¼ do.	4 0	2 6	2 0	1 6	1 2	0 11
Do., 3 to 11¼ do.	3 0	2 0	1 3	1 0	0 10	0 8
Bends and Lamp Bends	4 3	2 3	1 9	1 3	0 11	0 8
Springs, various elevations	3 3	1 8	1 4	0 11	0 9	0 7
FITTINGS.						
Square Elbows, equal or reducing	3 6	2 3	1 9	1 2	0 10	0 8
Round Elbows	3 10	2 6	1 11	1 4	1 0	0 9
Tees, equal or reducing	3 9	2 6	1 2	1 3	1 0	0 9
Crosses, do.	5 3	3 6	3 0	2 3	1 9	1 5
Sockets, reducing	1 3	0 11	0 9	0 7	0 6	0 5
Caps and Plugs	1 3	0 10	0 8	0 6	0 5	0 4
Nipples and Backnuts	1 0	0 8	0 6	0 4	0 3½	0 3
Sockets, plain	1 0	0 7	0 6	0 4	0 3½	0 3
Iron Main-Cocks	18 0	11 0	8 6	6 6	4 6	3 6
Syphon Boxes, 2 quarts	23 0	19 0	18 0	17 0	16 9	—

LONDON METAL MARKET.—*Per Ton.*

	£ s. d.		£ s. d.
Copper, tough cake	66 0 0	Tin, English block	131 0 0
Iron, Welsh bar	12 0 0	Tin-plates, best coke I. C.	1 12 0
Lead, English pig	23 10 0	Spelter, foreign	25 10 0

FREIGHTS.

COASTWISE.—*Per Ton.*

Newcastle—	s. d.	s. d.
Chatham and Rochester		—6 3
Cork (per keel) £13	0 0	—
Dover, Folkestone, and Ramsgate	6 3	—7 0
Dublin		—
Exeter Quay		—
Ipswich		—
London (from Leith)	6 3	—6 4½
London (Pool)		—6 0
Lowestoft and Yarmouth		—
Portsmouth and Southampton	7 6	—8 0
Plymouth (per keel) £8 10	0	—
Shoreham		—
Waitstable		—8 0
Weymouth		—

FOREIGN.—*Per Keel.*

	£ s.	£ s.
Barcelona		—21 0
Bordeaux		— 9 10
Boulogne and Calais		— 7 15
Cadiz		—14 0
Cronstadt		—
Copenhagen		—
Genoa		—20 0
Hamburg		— 8 15
Havre de Grace		— 9 0
Leghorn		—10 0
Lisbon		—11 0
Rotterdam		— 8 0
Stettin		—
Trieste		—20 0
Venice		—23 10

GAS COALS.—*Per Ton.*

Scotch Cannels, f.o.b.—	s. d.
Boghead, at Bo'ness	77 6
Capeldrae, at Burntisland	53 8
Cowdenbeath, do.	—
Donnibristle, do.	32 0
Kirkness, best, do.	53 8
Lesmahago (Auchin.), at Granton	46 0
Do. (Duke of Hamilton's), do.—	
Main	43 6
Wee	46 0
Do. (Nitshill Co.'s), do., and at Glasgow	47 6
Lochgelly, at Burntisland	—
Milton and Crosshill	38 8
Newcastle (Unscreened)—	Per Ton.
Haswells, Nettlesworth Primrose, and South Pelaw	—
Felling, Framwell Gate, North Pelton, Walker's Primrose, West Wear, and Whitwell Primrose	—
Burnhope, Charlaw, Derwent, East Castle, Edmondsley, Eighton Moor, Hartlepool Pelaw, Holmside, Lambton's Gas, Lanchester Pelaw, Medomsley, Mickley, New Pelaw, Pelaw Main, Pelton Main, Ravensworth, Seaham, South Moor Pelton, South Leverson, Townley Main, West Pelaw, Wearmouth Hutton, and Witton	—
Pearth, Ravensworth Pelaw, Waldridge, West Garesfield, and West Pelton	—
Brancepeth, Dean's Primrose, Londonderry Gas, New Pelton, South Pearth, Urpeth, Washington, and West Leverson	—
Ramsay's Newcastle Cannel	40 0
Wigan Cannel, f.o.b. at Liverpool	40 0

Scotch Cannels, f.o.b.—	s. d.
Arniston, at Leith	40 0
Billeyford, at Leith	26 0
Elphinstone Tower, do.	30 0
Grange Cannel, at Bridgeness	—
Haywood, at Granton	—
Kinniel, at Bo'ness	35 0
Lanemark, at Glasgow	—
Lochore, at Burntisland	53 8
Myles' do.	—
Pirnie, at Methill	26 6
Waverley Seam, at Burntisland	—
Old Wemyss Cannel, at Wemyss	45 0
Wemyss Rhumes Cannel	22 6

CHEMICALS.

Ammonia—	£ s. d.
Sulphate, white and grey	17 15 0
Do., brown, 23 per cent.	15 15 0
Benzole, 30 per cent.	0 2 3
Carbolic	0 1 3

Iron Salts—	£ s. d.
Green and rusty Copperas	3 10 0
Dry do.	2 15 0
Sulphuric Acid	3 10 0

SUNDRIES.

	£ s. d.	£ s. d.
Best Newcastle Fire-bricks, per 1000		— 4 0 0
Do., Fire-clay Retorts, per foot run	0 7 0	— 0 7 6
Cliff's Fire-bricks, at Wortley, per 1000		— 3 10 0
Ingham's best Wortley Fire-bricks, on rail or boat, per 1000		— 3 10 0
Farnley Iron Co.'s Fire-bricks, do., do.		— 3 10 0
Wortley Fire-clay Retorts, per foot run	0 5 6	— 0 7 6
Tarred Rope Yarn, per cwt.		—
Fraser's best Fire-bricks, f.o.b. at Inverkeithing		— 2 10 0
Do. Retorts, per foot run	0 5 0	— 0 7 6
Do. Ground Fire-clay, per ton		— 0 10 0
Stourbridge Fire-bricks, per 1000		— 3 0 0
Do. Fire-clay, per ton		— 0 12 0

Share List

OF

Metropolitan Gas and Water Companies.

(Corrected by Mr. F. N. Golding, Sun Court, Cornhill, from the latest Stock Exchange Quotations.)

Number of Shares issued.	Amount per Share.	Name.	Amount paid up p. Share.	Dividend p. Cent. p. Annum.	Latest Quotations.
	£	GAS COMPANIES.	£ s. d.	£ s. d.	£
8000	20	Anglo-Romano	20 0 0	10 0 0	22 — 24
5000	20	Bahia (Limited)	20 0 0	3 0 0	10½— 11½
1000	20	Do., preference	20 0 0	10 0 0	25 — 27
750	20	Do., do., redeemable	20 0 0	10 0 0	22 — 24
40000	5	Bombay (Limited)	5 0 0	6 15 0	5½— 6
10000	5	Do., third issue	4 0 0	6 15 0	¼—½ pm.
10000	20	British (Limited) (Norwich, Hull-Sculcoates, Hanley, Tunstall & Shelton [Potteries], Trowbridge., and Holywell.)	20 0 0	10 0 0	33 — 34
7500	20	Cagliari (Limited)	20 0 0	7 0 0	15 — 16
100000	10	*Chartered* A shares	10 0 0	10 0 0	14 — 14½
20000	10	Do., A	4 0 0	10 0 0	2½—3½ pm.
10000	10	Do., B shares, 4 per cent. max.	10 0 0	4 0 0	6½— 7½
25000	10	Do., 5 per cent. preference	10 0 0	5 0 0	12 — 12½
20000	10	Do., 5 per cent. preference, second issue	10 0 0	5 0 0	12 — 12½
20000	10	Do., 10 per cent. preference	10 0 0	10 0 0	19 — 20
12000	25	Do., D shares	25 0 0	10 0 0	48½— 49½
17490	100	*Commercial*	100 8 0	10 0 0	153 —155
20000	20	Continental Union	20 0 0	8 0 0	19½— 20
10000	20	Do., new	10 0 0	8 0 0	¼ dis— par
10000	10	Do., new, 1872	2 10 0	8 0 0	¼ dis—¼ pm.
10000	20	Do., preference (Grmny.: Strsbg. France: Cette, Nismes, Montargis Vienne, Roanne, Beaucaire, Rueil, Albi. Italy: Milan, Genoa, Parma, Modena, Alessandria, Messina.)	20 0 0	7 0 0	23 — 25
5000	10	*Crystal Palace District*	10 0 0	10 0 0	15½— 16
5000	10	Do., preference	10 0 0	6 0 0	11½— 12
10000	10	Do., new shares	10 0 0	7 0 0	11 — 12
23400	10	European (Limited)	10 0 0	8 0 0	13½— 14½
12000	10	Do., new shares (Boulogne, Amiens, Rouen, Caen, Havre, & Nantes.)	5 0 0	8 0 0	2 —2½ pm.
4054	10	Foreign and Colonial (Limited)	10 0 0	..	9 — 10
5000	10	Hong Kong (Limited)	10 0 0	10 0 0	13 — 13½
1560000	100	*Imperial*	100 0 0	10 0 0	159 — 161
26000	12½	Do., new shares	12 10 0	7 0 0	15½— 15¾
1500	100	Do., bonds	£100	10 0 0	195 —200
56000	50	*Imperial Continental* (Amsterdam, Berlin, Ghent, Hanover, Lille, Rotterdam, Aix-la-Chapelle, Antwerp, Bordeaux, Brussels, Cologne, Frankfort-on-Maine, Haarlem, Stolberg, Toulouse, & Vienna.)	43 15 0	9 2 6	36 — 38
3000	40	*Independent*	40 0 0	10 0 0	64 — 66
3000	10	Do.	10 0 0	5 0 0	7½ — 8½
3000	20	Do.	20 0 0	7 10 0	24½— 25½
	10	Do., D	1 0 0	..	—
250000	Stk.	*London*	100 0 0	10 0 0	153 —156
£15000	Stk.	Do., 1st preference	100 0 0	6 0 0	117 —120
	Stk.	Do., 2nd preference	100 0 0	6 0 0	—
	Stk.	Do., 3rd preference	100 0 0	6 0 0	—
£18781	100	Do., 1st preference stock	100 0 0	6 0 0	—
£11828	100	Do., 2nd preference stock	100 0 0	5 0 0	—
15000	5	Malta and Mediterranean (Limited)	5 0 0	5 0 0	2½— 3½
6000	5	Do., preference	5 0 0	7 0 0	5 — 5½
20000	5	Mauritius (Limited)	2 0 0	7 0 0	2 — 2½
25000	20	Monte Video (Limited)	20 0 0	..	22½— 23½
8000	10	Nictheroy, Brazil (Limited)	10 0 0	..	2½—2 dis.
30000	5	Oriental (Calcutta)	5 0 0	9 0 0	6½— 7½
30000	5	Do., new shares	2 10 0	9 0 0	¾—1¼ pm.
10000	5	Ottoman (Limited)	5 0 0	nil.	1½— 2½
17500	10	Pará (Limited)	10 0 0	7 0 0	7½— 8½
27000	20	*Phœnix*	20 0 0	10 0 0	31½— 32½
360000*l.*	100	Do., new	45 0 0	7 10 0	58— 60 pm.
144000*l.*	Stk.	Do.	100 0 0	5 0 0	89 — 91
5000	20	*Ratcliff*	20 0 0	10 0 0	31 — 32
34000	20	Rio de Janeiro (Limited)	20 0 0	10 0 0	36 — 37
7359	5	Singapore (Limited)	5 0 0	7 10 0	4½— 5
2000	5	Do., preference	5 0 0	7 10 0	5½— 6
1500	32½	Shanghai	32 10 0	12 0 0	30 — 32
4000	50	*South Metropolitan*	50 0 0	10 0 0	83 — 85
4000	12½	Do.	12 10 0	10 0 0	20 — 22
20000	12½	Do., new shares	2 10 0	10 0 0	3¾—4½ pm.
15000	10	*Surrey Consumers*	10 0 0	10 0 0	15½— 15¾
10000	10	Do., new	7 0 0	10 0 0	4½— 4¾
9000	4	United General (Limerick)	4 0 0	2 10 0	1¾— 2¼ pm.
1500	10	*Wandsworth and Putney*	10 0 0	10 0 0	14 — 15
1500	10	Do.	10 0 0	7 10 0	11 — 12
2957	10	Do.	10 0 0	7 0 0	
993	10	Do.	3 0 0	7 0 0	
16000	5	*West Ham*	5 0 0	10 0 0	7½ — 8½
10000	5	Do., new shares	1 10 0	10 0 0	3—3½ pm.
		WATER COMPANIES.			
60000	10	Berlin	10 0 0	11 10 0	17½— 18½
12000	100	Chelsea	100 0 0	6 0 0	116 —118
18000	100	East London	100 0 0	6 0 0	120 —122
10000	50	Grand Junction	50 0 0	8 10 0	76 — 78
5840	25	Do., ¼ shares	25 0 0	8 10 0	38 — 39
2160	25	Do., new do.; maximum dividend, 7½ per cent.	25 0 0	7 10 0	33 — 35
4396	100	Kent	100 0 0	6 0 0	119 —121
5339	100	Lambeth	100 0 0	6 5 0	120 —122
1161	100	Do.	20 0 0	6 5 0	
442	100	New River	100 0 0	8 0 0	170 —180
4443	100	Do.	20 0 0	8 0 0	36 — 38
4000	100	Do., debenture stock, 4 per cent.	100 0 0	4 0 0	96 — 98
3036	100	Southwark and Vauxhall	100 0 0	5 10 0	105 —106
1296	100	Do., preference stock	100 0 0	5 0 0	100 —102
	100	Do., D shares	100 0 0	5 10 0	102 —104
		Do., G shares	..	4 10 0	
	100	Do., new ordinary	..	4 10 0	
1600	100	Do., new ordinary, No. 1	40 0 0	4 10 0	
13913	61	West Middlesex	61 0 0	£6 per sh.	119 —121

SHEFFIELD GAS SUPPLY.—At the ordinary meeting of the Town Council, on the 9th inst., the mayor called attention to a letter of the gas company, published in the Watch Committee's minutes, giving notice of an increased charge for public lamps after July 1. In his opinion it was a very short-sighted policy on the part of the gas company to pursue a course like that. In order, he believed, to make up their 10 per cent. dividend, there was a deficiency of something like £1500, and the company were proposing to put £800 upon the corporation and £700 upon the large consumers. He thought the council would agree with him that a company, having a reserve-fund of £36,000, should not for such a small deficiency impose an additional tax upon the consumers. That reserve-fund was intended to meet such an emergency. They would all agree that these were exceptional times with regard to the price of coal; and he thought that if the company had taken the amount required from the reserve-fund, it would have been far wiser on their part than raising the price of gas to meet such a small requirement. It was possible that the company might at some time come into collision with the town, though he hoped it would not be in his time. There was additional reason why corporations should look after themselves He thought the policy of the company was also a bad one with regard to the large consumers, for the corporation knew to their sorrow when they were in conflict with the gas company that the latter were supported by the large consumers. He wished to enter his protest against the present proceedings of the company. Mr. Clegg asked what the increased price came to per lamp. The town-clerk said the increase was 3s. 3d. per lamp, the former charge being 31s. 11d. Mr. Clegg agreed that it was unwise on the part of the company to adopt the course they had taken, but he wished to know if the corporation had any power to prevent the increased charge. Alderman Hallam said there was a difference of opinion among the gas directors themselves with respect to the propriety of increasing the price, and the nominee directors urged the bad policy of the proceeding, pointing out that at the end of the last financial year the company had not only paid a dividend of 10 per cent., but had put something like £8000 into the reserve-fund during that 12 months; that the least they could do was to wait until the end of the present financial year before raising the charges, and that it would come with better grace to resort to the reserve-fund. He also told the directors that the corporation were not prepared to pay the increased charge, as their estimate was made upon the rate paid at the end of the previous year. He mentioned the matter again at the last meeting of the directors, with some hope that they would rescind their resolution; but he was sorry to say that the gentlemen who had expressed an opinion opposed to the advance appeared to have been talked over to the opposite view. He was, therefore, unable to obtain a reconsideration of the subject. His own opinion was that the council would do a great deal better without nominee directors, for they gave a good deal of time to no purpose, and were of no use whatever. Mr. Clegg moved a resolution to the effect that the council protested against the increased charge, and instructed the nominee directors to represent the matter to the directors of the company. Some further conversation took place, and in the end it was thought best not to pass any resolution upon the matter until it had been considered by the Watch Committee.

DUNDEE CORPORATION GAS-WORKS.—Those who were in the habit of visiting the Dundee Gas-Works some years ago, before their acquisition by the commissioners, and were familiar with the means employed for the manufacture of light, would be somewhat astonished to observe the changes which have recently been made, or are now in the course of being made, under the direction of Mr. M'Crae, the manager. When the commissioners got the works there were 11 holders for the storeage of gas. Of these eight were small and worn out, and besides were not suitable for the requirements of a town like Dundee. These have been removed, and the result has been to make available a large piece of ground which will be admirably adapted for extensions which may hereafter be required. On what was until a few months ago the site of two gasholders one is being built. The tank will be 122 feet in diameter, 25 feet deep, and 383 feet in circumference, and the gasholder which it will contain will be capable of storing 665,000 cubic feet of gas, or nearly double the quantity which can be put into either of the three now in existence. The tank is composed of solid masonry, the walls being 4½ feet thick, supported by counter fortes of uniform strength. The inner lining is all of dressed ashlar, with heavy cope on the top. The gasholder will be 120 feet in diameter; will be telescopic; and when full will rise 50 feet above the cope of the tank. Fifteen massive iron columns will constitute the guiding frame, the tops of them being joined together by lattice girders. The contractors for the tank are Messrs. A. and K. Macdonald, and the erection of the holder has been entrusted to Messrs. C. and W. Walker, Midland Iron-Works, Shropshire, who have also been commissioned to construct new and extensive purifying apparatus. When the operations presently in progress are completed, the storeage accommodation will be represented by four capacious holders. Hitherto the works have been greatly scattered, and the design of the arrangements carried out by Mr. M'Crae has been to secure more concentration, so that greater expedition might be employed in the different processes of manufacture. Notwithstanding that the holding capacity has been vastly increased, the spare ground which formed such an interesting subject of debate during the arbitration has been enlarged, and the available space is such that, without the acquisition of more land, it would be possible to make extensions to meet all demands likely to occur for very many years. The new purifiers will be placed on a portion of the ground previously occupied with some small gasholders. The situation is one which will conduce to the more economical management of the works, and in this respect also the improvements inaugurated in other departments will be subservient. It is the intention of the commissioners also at some future time to build on the bank at the north of the works a number of dwellings for their workmen. The contract for the new gasholder provides for its completion by the end of September, and present appearances indicate that the gentlemen who have the works in hand will do all that is expected of them. The different undertakings in which the commissioners are presently engaged will involve an outlay of about £17,000; but when they are finished the works will be in a singularly efficient state, and the probability is, should nothing unforeseen occur, that the expenditure for maintenance will not for some considerable period be of much consequence. Messrs. Macdonald have executed their contract in a most satisfactory manner; and from the standing of Messrs. Walker, who have just commenced the construction of the gasholder, there can be no doubt that they will be in no way behind. It is proper to mention that the plans for the extensions were prepared by Mr. M'Crae.—*Dundee Advertiser.*

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

2337.—WOTHERSPOON, J., Glasgow, "Improvements in closing the joints of gas-retorts, and in the means employed therefor." July 5, 1873.
2339.—GRICE, R. W., Aix-la-Chapelle, "Improvements in the manufacture of gas and coke." July 5, 1873.
2342.—BONNEVILLE, H. A., Rue de la Chaussée d'Antin, Paris, "Certain improvements in fluid-meters." A communication. (Complete specification.) July 7, 1873.
2353.—CAMPBELL, W. B., Hammersmith, and PARKER, J. W., Wood Green, Middlesex, "An improvement in gas-burners for use in street-lamps, offices, public buildings, and all places where gas is consumed." July 8, 1873.
2356.—SHEPHERD, J., Upper Wortley, near Leeds, "Improvements in machinery for manufacturing gas-retorts, &c." July 8, 1873.
2404.—ROBINSON, J., West Bromwich, "Improvements in machinery or apparatus for charging and discharging retorts, ovens, and furnaces." July 12, 1873.
2419.—SALMON, P., Burton Crescent, London, "Improvements in steam-boilers and gas apparatuses, and in gas engines and boilers." July 14, 1873.
2427.—SILBER, A. M., Wood Street, Cheapside, "Improvements in the construction of burners for the combustion of gas." July 14, 1873.
2453.—SOMERVILLE, J., Gas-Works, Dublin, and ROBINSON, J., West Bromwich, "Improvements in apparatus for discharging gas-retorts." July 16, 1873.
2454.—JACOBSON, F., Victoria Street, Edinburgh, "The clarification and purification of sewage, &c., by means of precipitation." July 16, 1873.
2471.—MULLER, J. A., Amsterdam, "Improvements in apparatus for measuring and registering the flow of water." July 17, 1873.

GRANTS OF PROVISIONAL PROTECTION.

2209.—IMRAY, J., Southampton Buildings, London, "Improvements in modules or apparatus for regulating and measuring the delivery of water or other liquids." A communication. June 25, 1873.
2235.—BOUSFIELD, G. T., Sutton, Surrey, "Improvements in lamps to be used for cooking, heating, and lighting purposes." A communication. June 27, 1873.
2245.—GRAHAM, D. A., Gas-Works, Stalybridge, "Improvements in the manufacture of gas and in the apparatus employed therein." June 28, 1873.
2259.—HENDERSON, A. C., Southampton Buildings, Middlesex, "Improvements in water, liquid, gas, and steam gauges." A communication. June 30, 1873.
2307.—GILES, B., Blackheath, Kent, "An improved apparatus for heating water." July 3, 1873.
2317.—MARSDEN, J., Bolton, and COLLINS, J., of the same place, "Improvements in the treatment of sewage water." July 4, 1873.
2337.—WOTHERSPOON, J., Glasgow, "Improvements in closing the joints of gas-retorts, and in the means employed therefor." July 5, 1873.
2356.—SHEPHERD, J., Upper Wortley, near Leeds, "Improvements in machinery for manufacturing gas-retorts." July 8, 1873.

INVENTION PROTECTED FOR SIX MONTHS ON THE DEPOSIT OF COMPLETE SPECIFICATION.

2342.—BONNEVILLE, H. A., Rue de la Chaussée d'Antin, Paris, "Certain improvements in fluid-meters." A communication. July 7, 1873.

NOTICES TO PROCEED.

726.—BRAKELL, C., Manchester, engineer, "Improvements in machinery and apparatus for exhausting, discharging, and transmitting, air, water, or other fluids." Feb. 27, 1873.
1555.—BROWN, W., Stockwell, Surrey, "Improvements in the treatment of sewage, and in the manufacture of manure therefrom." April 29, 1873.
2152.—M'AVOY, H. L., Baltimore, U.S.A., "Improvements in apparatus for carburetting air for illuminating or heating purposes." June 19, 1873.
2199.—NICHOLSON, B., Dulwich, Surrey, "Improvements in junctions for gas and water mains and branches." June 24, 1873.
2209.—IMRAY, J., Southampton Buildings, London, "Improvements in modules or apparatus for regulating and measuring the delivery of water or other liquids." A communication. June 25, 1873.

BEALE'S IMPROVED PATENT GAS-EXHAUSTERS,

WITH

GWYNNE & BEALE'S

PATENT

IMPROVEMENTS,

Made under the personal superintendence of

Mr. BEALE,

The oldest Maker, Inventor and Patentee of GAS-EXHAUSTING MACHINERY.

It is NOT CORRECT to state that Mr. BEALE has RETIRED.

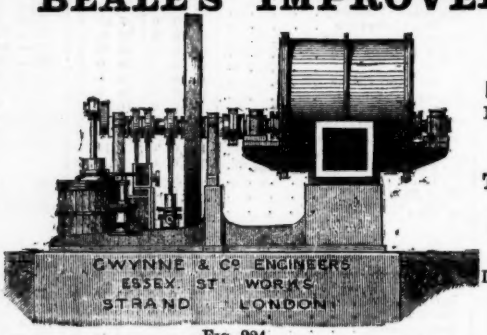


FIG. 224.

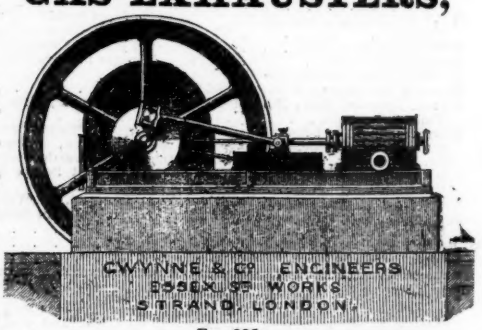


FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the **most perfect system of action yet discovered.** Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND CO. do not pretend to enter into a struggle with other makers in respect to **cheapness.** They have never sought to make **price the chief consideration,** but to produce Machinery of the very highest quality, and the most approved design and arrangement. Their prices have been estimated with a due regard to the **excellence of the article produced,** and when this is taken into consideration, they have no fear for the result.

The orders executed this season for Exhausters and alterations to their patented system, amount to over 3,000,000 cubic feet of gas passed per hour, and to over 200 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction.

REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES

CAN BE HAD ON APPLICATION TO

GWYNNE & CO., HYDRAULIC & GAS ENGINEERS, ESSEX STREET WORKS, STRAND, LONDON, W.C.

Prices and every information on application.

G. & Co. are now manufacturing for a London Gas Company two of their 210,000 cubic feet Patent Gas Exhausters.

DUKE OF HAMILTON'S
LESMAHAGOW GAS COAL.

The superior quality of this well-known Cannel, as wrought by

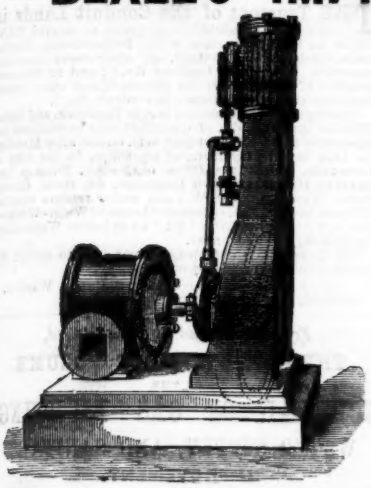
THE NITSHILL AND LESMAHAGOW COAL COMPANY,

Is now generally admitted by all Gas Engineers.

PRICE AND ANALYSIS MAY BE HAD ON APPLICATION TO

JAMES M'KELVIE, HAYMARKET, EDINBURGH.

BEALE'S IMPROVED PATENT GAS-EXHAUSTER



WITH

ENGINE COMBINED

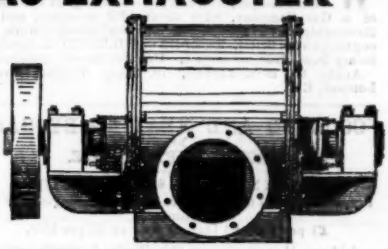
ON

ONE BASE PLATE.

SOLE MAKERS,

GEORGE WALLER & CO.,

Who, since Mr. BEALE'S retirement, are the Oldest Makers.



EXHAUSTERS with HORIZONTAL ENGINE combined.
EXHAUSTERS with OUTSIDE BEARINGS.
MAKERS of ENGINES, BOILERS, and GAS MACHINERY.
TAR, LIQUOR, and SYPHON PUMPS. GAS-VALVES in stock, 2 to 30 inches.
SELF-ACTING BYE-PASS VALVES, with Lid and Relieving Lever.
MANN'S and many other descriptions of WATER DISTRIBUTORS,
SCRUBBERS, PURIFIERS, and CONDENSERS.
EXHAUSTERS from 3000 to 60,000, new and second hand, in stock.

PHŒNIX ENGINEERING WORKS, HOLLAND STREET, S.E., & at STROUD, GLOUCESTERSHIRE.

THE FARNLEY IRON COMPANY, LIMITED,

FARNLEY, near LEEDS,

MANUFACTURERS OF

FIRE-CLAY GAS-RETORTS & FIRE-BRICKS,

Of every size and shape, and of the best quality; also of White and Coloured GLAZED BRICKS, SANITARY PIPES, &c., &c.

The F. I. Co. have the exclusive right to make and sell Fraser's Patent "Ribbed" Gas-Retorts in Fire-Clay.

In order to meet the constantly increasing demand for their Gas-Retorts, the F. I. Co. have recently made such an addition to their premises as will enable them to execute expeditiously the largest home or foreign orders.

Apply as above, or to the London Offices, 15, NEW BROAD STREET, E.C.

THE STEAM STOKER COMPANY, LIMITED,

ARE NOW PREPARED TO GRANT

LICENCES FOR THE USE OF THEIR VARIOUS PATENTS

FOR

STOKING BY MACHINERY.

UNDER one or the other of their Patents, Machines can be adapted to almost any existing works without material alteration of the Retort-Houses or Settings.

Applications, accompanied by full particulars as to dimensions of the Retort-Houses, Settings of the Retorts, &c., &c., should be addressed to the Secretary, at the Offices of the Company,

155, FENCHURCH STREET, LONDON, E.C.

VICKARYS AND ROBERTSON,

Late JOHN VICKARY,

ESTABLISHED 1840,

GAS ENGINEERS, CONTRACTORS, IRON AND BRASS FOUNDERS,

WEST OF ENGLAND ENGINEERING WORKS, EXETER.

GASHOLDERS AND TANKS,

Retorts, Retort-Fittings, Condensers, Scrubbers, Purifiers, Station-Meters, Governors, Rack and Screw Valves. Gas and Water Mains always in Stock.

STEAM-ENGINES, EXHAUSTERS, SHAFTING AND GEARING, &c.

GAS-FITTINGS,

Including Chandeliers, Pendants, Hall Lamps, Brackets, Star and Sun Lights of all designs.

WET & DRY GAS-METERS,

Combining most recent improvements in principle and manufacture; upwards of 200,000 already in work, giving highest satisfaction.
(A guarantee of five years given with every Meter.)

PLUMBERS WORK, including Lift and Force Pumps; Cocks for Gas and Water and Steam; Brass Fittings.

HYDRAULIC AND GENERAL ENGINEERING

LONDON OFFICE: 8, JOHN STREET, ADELPHI, W.C.

WANTED, a Gas-Fitter; one who can repair meters, wet and dry.
Apply to J. DAVIES, Gas-Works, KINGSGROVE.

WANTED, by the Blaenavon Gas and Water Company, a steady young man as STOKER. Liberal wages and coal found.
July 26, 1873.

WANTED, by the Sherborne Gas Company, a steady MAN, who understands the erection of fittings, laying mains and services, and is thoroughly accustomed to the routine of a Gas-Work. Character and testimonials required.
Apply to T. W. B. WHITE, Manager and Secretary.
July 26, 1873.

WANTED, by a first-class (double entry) book-keeper, who has had sole charge of the books of a Gas Company, with about 1200 accounts, and is thoroughly experienced in collecting and all office work, an engagement as BOOK-KEEPER or COLLECTOR. Aged 27. Salary from £200 per annum. Unexceptionable references.
Apply to BOOK-KEEPER, 79, King William Street, LONDON, E.C.

COOKING AND HEATING BY GAS,
BY
MAGNUS OHREN, A.I.C.E.
NEW AND REVISED EDITION.
Prepared for Gas Companies to circulate amongst their gas consumers.
£1 per 100; £3 15s. per 500; or £6 per 1000.
Address, MAGNUS OHREN, Gas-Works Lower Sydenham, London, S.E.

COST PRICE SHEETS.

MANUFACTURE AND DISTRIBUTION OF GAS. These sheets are the same as were laid before the Dublin Meeting of the British Association of Gas Managers; but in the REPRINT, NOTES have been added for the guidance of those using them. Copies of the two sheets may now be had, price 5s.
South Shields, January, 1873. W. J. WARNER.

PUPIL WANTED.

THE Advertiser is open to take a Youth about 16 or 17 years of age as an ARTICLED PUPIL. He would have good opportunities of acquiring a thorough knowledge of the management and erection of both Gas and Water Works.
For terms, &c., apply to T. A. DREW, Engineer and Manager, Gas and Water Works, WIDNES.

FOR SALE—A good Station-Meter, to pass 2500 feet per hour, with 6-inch connexions and bye-pass complete.
Apply at the GAS-WORKS, Holywood Company, DOWN.
Holywood, July 8, 1873.

FOR SALE—One 40 ft. by 16 ft. Gasholder, at present in use, with 7-in. inlet and outlet pipes and hydraulic valves complete.
Can be seen working at the Radcliffe and Pilkington Gas-Works, near Manchester, or any information can be obtained respecting the same by application to D. BRANDWOOD, the Company's Manager and Secretary.
July 7, 1873.

FOR SALE, a Set of Four Second-hand PURIFIERS, 5 ft. square, 2 ft. 6 in. deep, inlet and outlet 6 in., with 5-in. connexions; four tiers wood sieves or grids to each, hydraulic centre-valve, lifting apparatus and girders, heavy castings, and fastened with ½-in. angle iron. Removed to place Purifiers of larger dimensions.
For price and particulars, apply to THOS. H. BOUTTELL, Manager and Analyst, Gas-Works, SLEAFORD.

TO BE DISPOSED OF, in consequence of being replaced by larger ones, a pair of 6 H.P. VERTICAL ENGINES, with oscilating cylinders, and a pair of 20,000 feet per hour Rotary Exhausters, with all valves and connexions.
Also 28 15-in. D Mouthpieces and Ascension-Pipes to suit.
The above are in good condition, and will be sold together or separately.
Apply to W. C. WATSON, Engineer, Gas-Works, KINGSTON-ON-THAMES.

THE Gas-Works Committee of the Widnes Local Board are prepared to receive TENDERS for the supply of an EXHAUSTER of 20,000 cubic feet per hour capacity, also for an ENGINE of about 10 horse power, particulars of which may be obtained on application to the undersigned.
Offers to be addressed to the Chairman of the Gas-Works Committee, endorsed "Tender for Engine or Exhauster," and delivered at the Gas-Works, Widnes, not later than the 2nd of August next.
The Board does not bind itself to accept the lowest or any tender.—By order of the Board,
T. A. DREW, Engineer, &c.
Gas-Works, Widnes, July 9.

TO COAL AND CANNEL PROPRIETORS.

THE Gas-Works Committee of the Widnes Local Board are prepared to receive TENDERS for the supply of about 6000 tons of GAS COAL and CANNEL, to be delivered free on their siding at the Gas-Works, Widnes, in such quantities and at such times as may be required, the whole to be delivered between the 15th of August next and the 1st of June, 1874. Further particulars may be obtained on application to the undersigned.
Offers to be addressed to the Chairman of the Gas and Water Works Committee, endorsed "Tender for Gas Coal," and delivered at the Gas-Works, Widnes, not later than the 2nd of August next.
The Board does not bind itself to accept the lowest or any tender.—By order of the Board,
T. A. DREW, Engineer and Manager.
Gas-Works, Widnes, July 9.

TO COKE CONTRACTORS AND OTHERS.

THE Directors of The Gaslight and Coke Company are prepared to receive TENDERS for the purchase of the whole or any portion of the COKE which will be manufactured at their works at Beckton, on the river Thames, near Barking Creek, for One year, from the 1st of October next.
Tenders should state the price per chaldron of 36 bushels for delivery free on board barges alongside the Company's wharf at Beckton, or into trucks on the Company's line of railway which communicates with the Great Eastern Railway near North Woolwich.
Contractors may be required to enter into a bond, with sureties, for the due performance of their contract.
Payments monthly, in cash.
Further information, if desired, may be obtained at this Office, on application to the undersigned, to whom sealed tenders, marked "Tender for Coke," should be sent on or before Thursday, the 31st inst.—By order,
JOHN ORWELL PHILLIPS, Secretary.
N.B.—The Directors do not bind themselves to accept the highest or any tender, and reserve to themselves the right of accepting the whole or any portion of one tender.
Horseferry Road, Westminster, July 12, 1873.

TO COKE CONTRACTORS AND OTHERS.

THE Directors of The Gaslight and Coke Company are prepared to receive OFFERS from parties willing to undertake the SALE, on commission, of COKE manufactured at their works at Beckton for One year, from the 1st of October next.
Further information, if desired, may be obtained at this Office, on application to the undersigned, to whom sealed tenders, marked "Sale of Coke on Commission," containing reference to a London Banker, should be sent on or before Thursday, the 31st inst.—By order,
JOHN ORWELL PHILLIPS, Secretary.
Horseferry Road, Westminster, July 12, 1873.

TORBANEHILL MINERAL.

For Sale, by Tender,
FOR WHOLE OR PART,
SEVERAL THOUSAND TONS OF THE
Celebrated Torbanehill Mineral,
Saved from the fire at Torbanehill in June last.
The mineral as it at present lies has been examined and analyzed by Dr. WILLIAM WALLACE, Analytical Chemist, Glasgow, who says:
"Very great care was employed to obtain reliable average samples, and the results show that the mineral is not appreciably damaged."
The results of two testings of fair samples of the Coal give 14,680 cubic feet of 43·7 candle gas.
APPLY TO
MR. DAVID STEWART,
128, INGRAM STREET, GLASGOW.

MR. WILLIAM DORE (19 years Gas Engineer and Accountant) may be CONSULTED upon all matters relating to the manufacture and distribution of gas, and the management, accounts, or transfer of gas undertakings.
Office, 4, Picton Place, Neath, SOUTH WALES.

THE NEW GAS COMPANY, LIMITED.

THE Directors of the above Company are ready to receive APPLICATIONS from owners of existing Gas-Works, as well as from others erecting or about to erect new works, and to grant Licences for the use of the Patents.
Apply to the SECRETARY, 22, WALBROOK, E.C.

LICHFIELD WATER-WORKS.

CONTRACTS Nos. 1 & 2.
TO BUILDERS AND CONTRACTORS.

THE Trustees of the Conduit Lands in the City of Lichfield are prepared to receive TENDERS for the construction of an Engine-house, Boiler-house, Cooling Pond, Cottage, and other works connected therewith, included in Contract No. 1; and for the construction of a covered Service Reservoir, and other works connected therewith, included in Contract No. 2.
Drawings and specifications may be inspected, and forms of tender and schedules of quantities may be obtained (on payment of One Guinea for each set), on and after Monday, the 14th day of July inst., at my Office, in the City of LICHFIELD, and at the Office of Messrs. THOMAS AND CHARLES HAWKSLEY, Civil Engineers, 30, Great George Street, WESTMINSTER, S.W.; and sealed tenders must be delivered at my Office, endorsed "Lichfield Water-Works—Tender for Contracts Nos. 1 & 2," on or before Wednesday, the 13th day of August next.
The Trustees do not pledge themselves to accept the lowest or other tender.—By order,
HENRY S. CHINN, Warden.
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Requiring New Street-Lamps are recommended
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DOUBLE-CLIP
STREET-LAMP.
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They have been sold to various Gas-Works throughout the country and abroad, and the highest satisfactory testimonials are given as to their superiority.
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NEAR LEEDS,
MANUFACTURERS OF ALL DESCRIPTIONS OF
FIRE GOODS, and Salt-Glazed Drain-Pipes.
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IMPROVED VENTILATING SUN-LIGHTS

WITH TALC REFLECTORS AND SELF-ACTING VALVES

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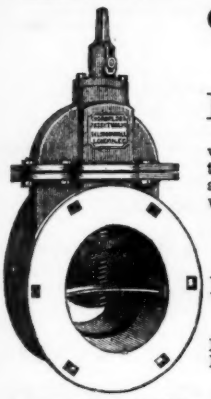

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Copy Testimonial.—A series of experiments have taken place at the Erith Gas-Works with "Chandler's Patent Dip-Pipe," which was found to prevent any deposit of carbon taking place at the back or on the surface of the clay retorts; there was also considerable increase of gas per ton of coal carbonized, whilst the apparatus continues working with the greatest simplicity and certainty.

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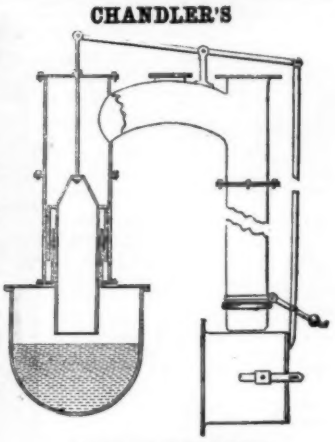

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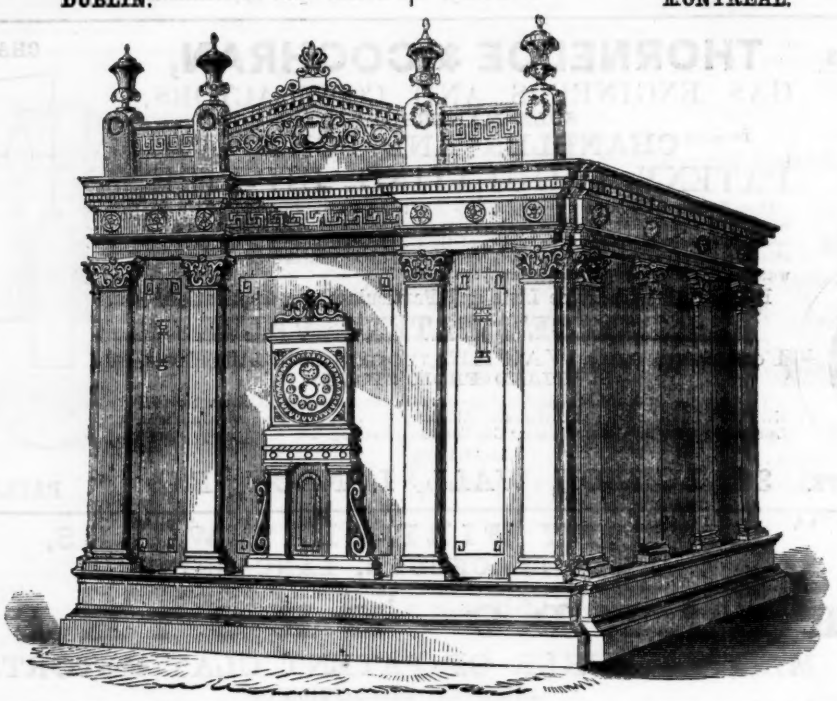

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To examine the Books and Accounts, and prepare Balance-Sheets for the information of Directors.

To assist Secretaries in preparing Balance-Sheets, according to the "Gas-Works Clauses Act, 1871;" or may be consulted with respect to Accounts generally.

SAMUEL PONTIFEX, Consulting Gas Engineer, having retired from the Great Central Gas Company, is now prepared to furnish PLANS and SPECIFICATIONS, as well as ADVISE Provincial Gas Companies as to the erection of new, or alteration and enlargement of existing works.
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Admitted to be the best and most economical for lighting factories, railway stations, mansions, country houses, and other isolated buildings.

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Being a Popular Exposition of the Chemistry of Gas Lighting, with Practical Instructions in the best methods of burning Gas for Lighting, Cooking, and Heating; and Suggestions as to the proper Sizes of Interior Pipes, Arrangement of Lights, &c., &c.

ILLUSTRATED.

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Extract from Report by Dr. Letheby:—

"The results have been very remarkable, for they show an average increase of 63 per cent. on the illuminating power of the gas. I am of opinion, therefore, that the invention is of great practical value."

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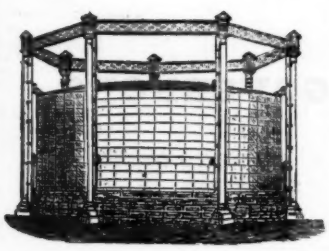

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Experienced Retort Setters sent to any part of the Kingdom.

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IMPROVED WOOD SIEVES

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The above Sieves are used by all the Gas Companies in London and a great many in the country. Their utility, durability, and cheapness combined, render them superior to all others.

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All orders punctually attended to, and estimates given if required.

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For excellence of Fire-Clay Gas Retorts, and

"HONOURABLE MENTION" for good quality of Fire-Bricks.

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BRONNER'S PATENT GAS-BURNERS give 99 per cent. of light, as compared with 27 per cent. given by ordinary burners, with equal consumption of gas.—*Vide* "Gas Referees Report," published June, 1860.

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J. SUGG and CO., late ALBERT KELLER, GHENT.—The removal of the import duties on Earthenware permitting the entry of Clay Retorts into England, Messrs. Sugg, of Ghent, beg to draw the attention of the Gas Companies of London, and other Cities, to the very superior quality of the RETORTS manufactured by them. They can be made of any size, in one piece, and of any form. The price will be in proportion to the weight, and very moderate in comparison to their value.

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These Sieves are made with parallel or bevel bar, and guaranteed to be well seasoned yellow deal, and not common spruce so generally used.

N.B.—Specimens sent free on application.

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AND

WENLOCK IRON WHARF, 20 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,

Beg to inform Gas and Water Companies and the public, that they keep in stock in London all the CASTINGS in general use in Gas and Water Works, including Iron Retorts, Socket and Flange Pipes, Bends, Branches, and Syphons of all sizes, Lamp Columns, &c., &c.

N.B.—Orders for Cast-Iron Tanks, Girders, Columns, Cylinders, and all irregular castings, will have immediate attention. CHARLES HORSLEY, Agent.

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CONTRACTING ENGINEER

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GAS & WATER WORKS,

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Foreign Orders carefully executed. Provincial Gas-Works designed and erected. Extensions of Works carried out with despatch. Mains supplied and promptly laid. Public and Private Buildings fitted up. Gasholders, Purifier Covers, and all Sheet Ironwork. Wrought Ironwork to drawing.

Specifications, Estimates, and Tenders given.

GAS-WORKS LEASED.

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MANUFACTURERS OF

WET AND DRY GAS-METERS,

PRESSURE-GAUGES AND GOVERNORS, AND STREET-LAMP REGULATORS.

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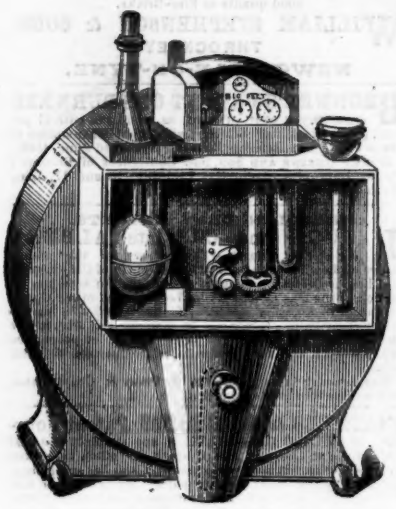


Front View.

THE

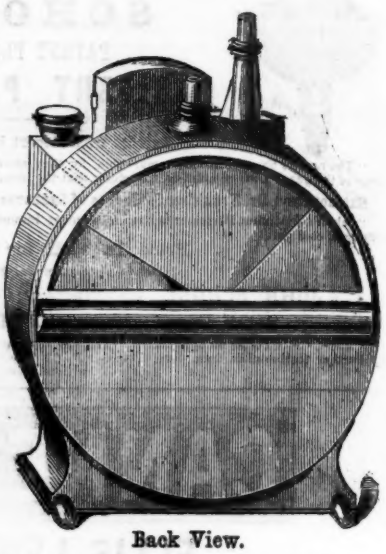
IMPERIAL

COMPENSATING

WET GAS-METER.

DE CASTRO & BURTON'S

PATENT.



Back View.

I. **This Meter is more simple in construction than the common non-compensating Meter.**
II. **An unvarying water-line is maintained.**
III. **No amount or kind of pressure will cause it to "flood."**
IV. **It is practically unaffected by "tilting."**
V. **The friction is less than in any other Meter; and**
VI. **It will last for twelve months without requiring to be refilled.**

THE IMPERIAL METER COMPANY, LIMITED, ALSO MANUFACTURE COMMON NON-COMPENSATING WET GAS-METERS OF ALL SIZES, BOTH IN TIN AND CAST-IRON CASES.

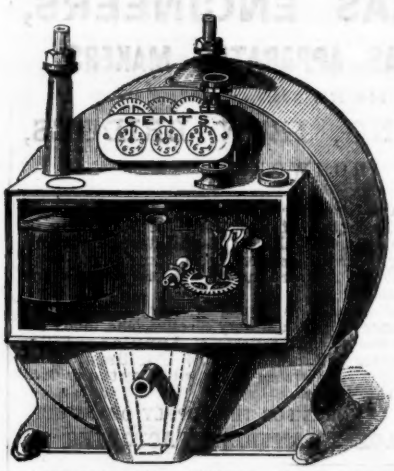
THE COMPENSATING

WET GAS-METER

IS UPHELD FOR

TEN YEARS

WITHOUT CHARGE.



THE IMPERIAL WET GAS-METER.
Non-Compensator.

STATION-METERS

WITH PLANED JOINTS,

AND

GOVERNORS,

MADE TO ORDER.

Mr. GEORGE MACKANESS will represent this Company in the Provinces.

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W. MOORE, Secretary.

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THE IMPERIAL METER COMPANY, LIMITED,

MANUFACTURERS OF

WET AND DRY GAS-METERS,

PRESSURE-GAUGES AND GOVERNORS, AND STREET-LAMP REGULATORS.

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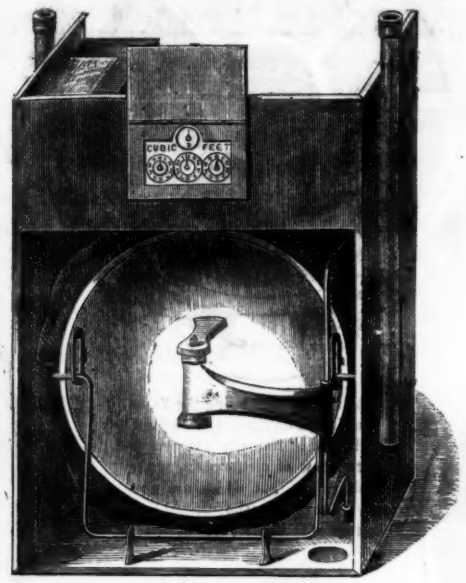


Front View.

THE

IMPERIAL

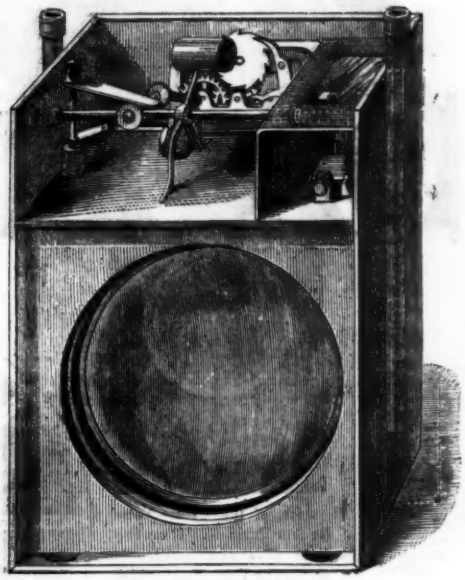
DRY

GAS-METER

SINGLE DIAPHRAGM.

TELLING & JOHNSON'S

PATENT.



Back View.

I. The mechanical construction of this Meter is simpler and stronger than any other.
II. About half as much leather is used as in ordinary dry Meters.
III. The Meter has only one valve, and this cannot "stick."
IV. The lights maintain perfect steadiness and strength of flame. There is no "draw."
V. The gas consumed can only be measured from the inlet to the outlet, and
VI. The index cannot be made to register backwards.

THE IMPERIAL METER COMPANY, LIMITED, ALSO MANUFACTURE ORDINARY DOUBLE DIAPHRAGM DRY GAS-METERS OF ALL SIZES, BOTH IN TIN AND IN CAST-IRON CASES.

SPECIAL ATTENTION

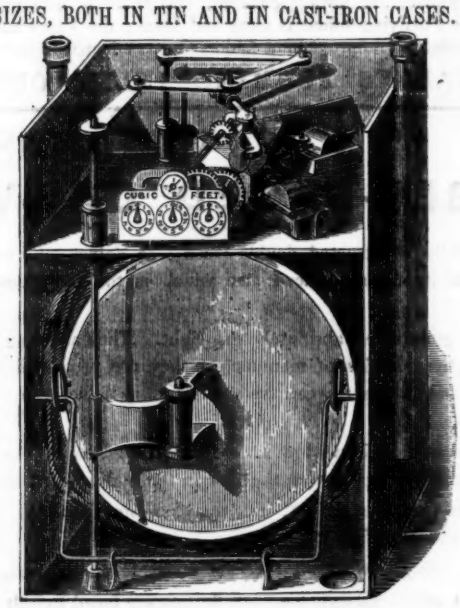
IS PAID TO THE

MANUFACTURE OF

STREET-LAMPS

AND

REGULATORS.



EVERY

DRY GAS-METER

IS UPHELD FOR

SIX YEARS

WITHOUT CHARGE.

THE IMPERIAL DRY GAS-METER.
Double Diaphragm.

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W. MOORE, Secretary.

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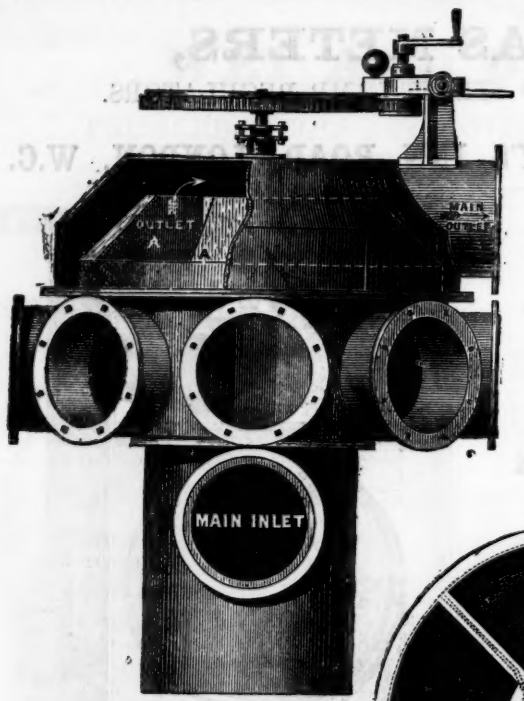
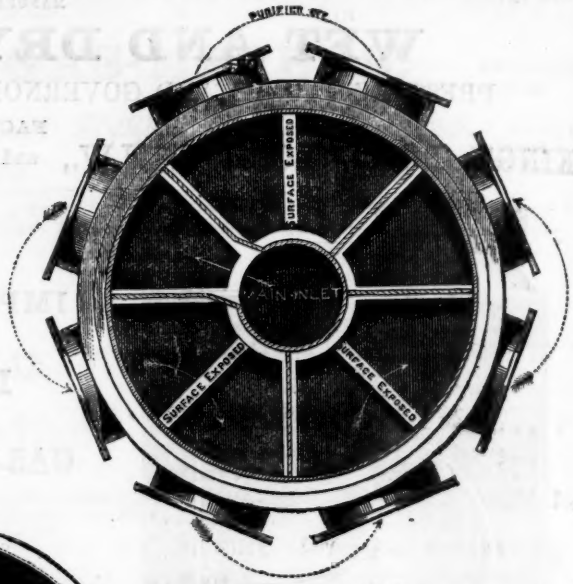
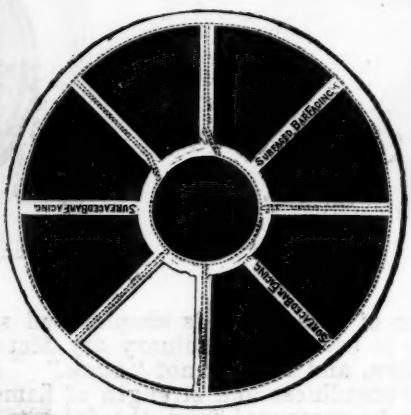
C. & W. WALKERS' PATENT CENTRE-VALVES.



Elevation of the Centre-Valve for four Purifiers. The safety cover is shown broken, to enable the Valve itself, which is inside, to be seen.



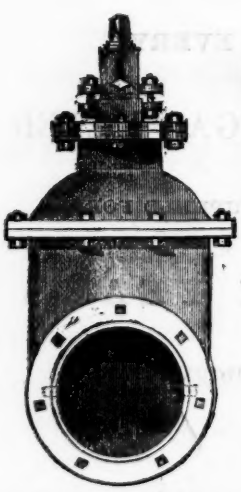
Plan of the Body, showing the Valve lying in it, with three of the facings, which were formerly exposed to settlements of dirt, carbon, naphthaline, &c., but which are now always covered by the surfaced bar-facings of the Valve. (See below.)



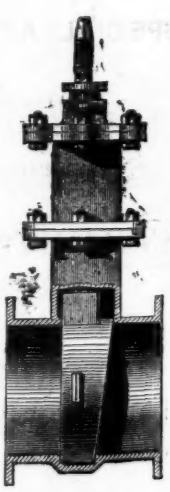
Plan of the Valve, or upper portion, showing the surfaced bar-facings referred to above.

These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A very considerable improvement and saving is effected in the cost of the connecting-pipes.

FOUR-WAY CENTRE-VALVES FORMING INLET, OUTLET, AND BYE-PASS.



C. & W. WALKERS'
DOUBLE-FACED GAS-VALVES.



These solidly constructed double-faced Gas-Valves are superseding the old system of the light, single-faced disc, which is too uncertain and unreliable in large bores.

They are guaranteed absolutely gas-tight. They are very massive and rigid, and by improved modes of manufacture they are produced at very little excess in cost over the old light, weak system, which is liable to spring and bend, and become leaky.

The Valve is a rigid wedge of solid cast iron, having two perfectly scraped surfaced facings fitting between the two on the body, which are also surfaced.

A spring in two short halves, and, therefore, not liable to break, is used only for scraping the front facing clean.

The front facing is vertical; the back facing forms the wedge.

At a slight additional expense both flanges are faced to bolt to main-pipes.

GASHOLDERS, TELESCOPE & SINGLE-LIFT, of LARGEST DIMENSIONS.

PURIFIERS, SCRUBBERS, CONDENSERS of most Improved Description.

WOOD SIEVES FOR PURIFIERS,

Which have now been in use for more than ten years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.

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AND FOR THE

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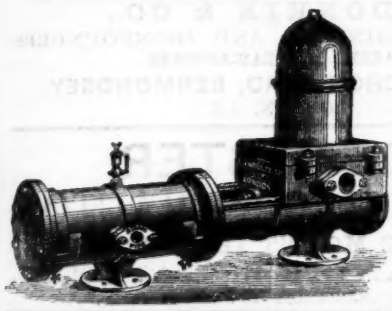
AND ALL MATERIALS FOR GAS MANUFACTURE AND DISTRIBUTION.

THE PATENT

"UNIVERSAL" STEAM PUMP.



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(Signed) PETER HART, *Manager.*

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FOR

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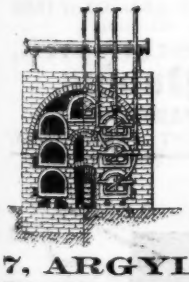
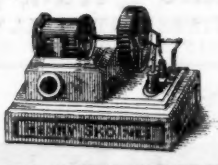
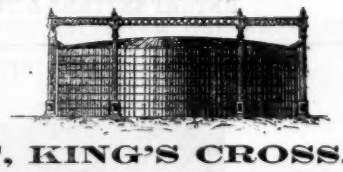
ERECTING AND REMODELLING GAS-WORKS

OF ANY EXTENT, AT HOME AND ABROAD.

RETORTS RESET, and the whole or any portion of Gas Apparatus supplied to the Trade, with their choice of name and device, if desired.







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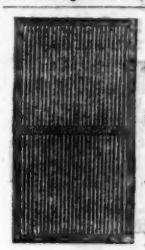

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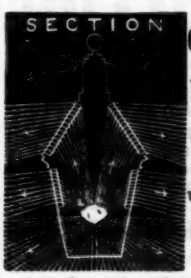

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for Streets and all Situations where the Light ascending above the level of the Lamp is wasted,

Is now in use in Moorgate St., London, and has been in successful operation upon Waterloo Bridge since Oct. 7, 1871.

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Successors to
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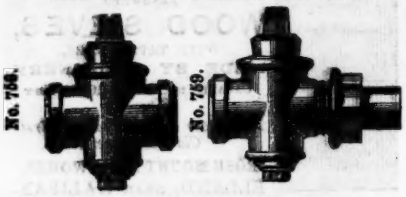
CAST-IRON GAS-MAIN COCKS,
WITH PATENT WHITE METAL PLUGS.



The bodies of these Taps are made of Iron, black or galvanized, and the Plugs of Patent Metal. They are warranted not to set fast or corrode as do iron or brass Cocks, will always work easily, are strong, well made, durable, of little or no intrinsic value, and, therefore, not likely to be stolen; and the PRICES are (especially upon the larger sizes) FULLY 50 PER CENT. LESS THAN BRASS COCKS.
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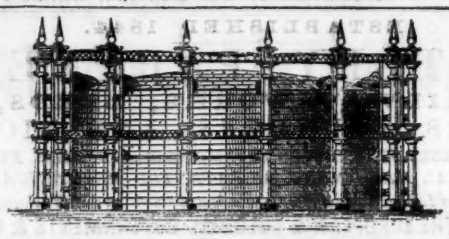

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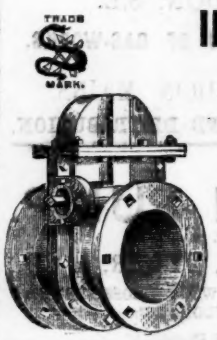

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These Valves are all proved on both sides to 30 lbs. on the square inch before leaving the works, and are always kept in stock.
VALVES MADE WITH OUTSIDE RACKS TO ORDER.
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GAS EXHAUSTERS,
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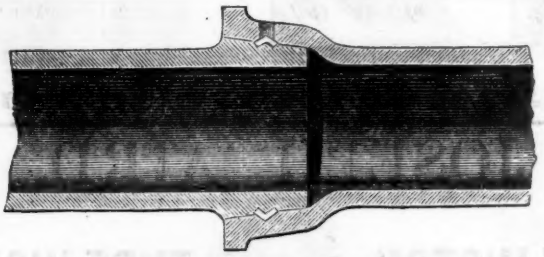

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Require no "yarning," no "setting up," nor increased excavation for joint-holes, while less lead and less labour suffice for the making of joints, which have been proved to withstand 95 lbs. on the square inch, have stood the test of more than two years practical use, and must, from the principle of their construction, remain sound.
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And every Description of Gas Apparatus.

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STATION GOVERNORS—the Gasholder cannot tilt and cause accident.

BREEZE AND TAR FUEL MACHINE.

A Pamphlet containing Eighteen Illustrations of the foregoing, with letterpress on the construction of Works, post free, 2s. 6d.

N.B.—The second edition of this Work, *now ready*, contains illustrations of the Machine for converting Breeze and Tar into Fuel for heating the Retorts.

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Yields 11,900 cubic feet of 35-candle gas per ton. Coke worthless.

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One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

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OLD WEMYSS CANNEL COAL.—Yield of gas per ton, 12,896 cubic feet; illuminating power, 31·75 standard candles. Port of shipment, Wemyss.

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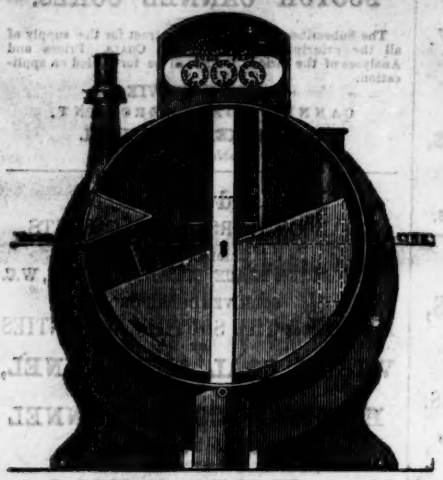

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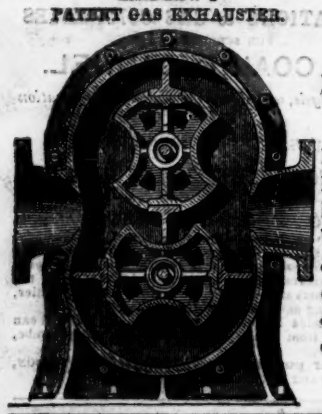

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